Evaluating river restoration appraisal procedures: the case of the UK

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'Finally I took a walk along to the levee, I wanted to sit on the muddy bank and dig the Mississippi River; instead of that I had to look at it with my nose against a wire fence. When you start separating the people from their rivers what have you got? 'Bureaucracy!' says Old Bull' (Kerouac,1957: 141).

Abstract

The primary aim of this thesis is to detail and evaluate the appraisal frameworks and techniques employed on river restoration projects in the UK. This research evaluates the extent to which restoration projects have implemented the appraisal frameworks and techniques proposed in the practical restoration literature, and examines barriers to the incorporation of appraisal into river restoration projects. An ideal type appraisal framework is developed in this thesis and is used as a tool against which to evaluate the nature and extent of UK river restoration project appraisal.

This research was undertaken through a national and a regional investigation of appraisal procedures. The national investigation is designed to be extensive and aims to draw out the basic dimensions of river restoration projects and appraisal. The regional investigation, in contrast, intensive adopting a case study approach which examines in detail how appraisal has and has not been implemented. The *national investigation* involved a questionnaire survey, sent to 161 people involved in 440 river restoration projects (80% response rate achieved). The *regional investigation* of the Thames region of the Environment Agency (EA) focused in detail on three case study sites (River Ravensbourne, River Cole and Upper River Kennet) undertaking twenty-five in-depth interviews with restoration practitioners. This enabled the appraisal and decision-making structures of these three projects to be evaluated. This thesis argues that it is not only the structure of a project's appraisal which influences a project's trajectory but also the nature and composition of the decision-making structure. The influence of scientific and lay knowledge in decision making is also explored.

This thesis concludes by drawing together key empirical, theoretical and practical findings from these investigations. The results of this research are discussed and evaluated against how effectively UK river restoration projects incorporate the ideal type appraisal framework proposed in Chapter 2. The results of this research are further evaluated in the light of a workshop on river restoration appraisal (undertaken in November 2002) where appraisal frameworks are discussed and ways of including appraisals in river restoration projects are put forward.

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Abbreviations

AONB	Area of Outstanding Natural Beauty
BAP	Biodiversity Action Plan
CBA	Cost Benefit Analysis
CEC	Commission of the European Community
CRRP	Cole River Restoration Project
DARD	Department of Agriculture and Rural Development (Northern Ireland)
DEFRA	Department of the Environment, Farming and Rural Affairs
EA	Environment Agency
EC	European Community
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EU	European Union
FHRC	Flood Hazard Research Centre
FISRWG	Federal Interagency Stream Restoration Working Group
GIS	Geographic Information System
HABSCORE	Assesses river habitat quality by prediction of Salmonid populations
HMWB	Heavily Modified Water Body
MAFF	Ministry of Agriculture Food and Fisheries
NRA	National Rivers Authority
NRC	National Research Council
PHABSIM	Physical Habitat Simulation Model
QMRG	Queen's Mead Recreation Ground
RBD	River Basin District
RBMP	River Basin Management Plan
RCS	River Habitat Survey
RHS	River Corridor Survey
RIVPACS	River Invertebrate Prediction and Conservation System
RRC	River Restoration Centre
RRP	River Restoration Project
SEPA	Scottish Environmental Protection Agency
SERCON	System for Evaluating Rivers for Conservation
SSSI	Sites of Special Scientific Interest
TW	Thames Water
UKRP	Upper Kennet Rehabilitation Project
UNCED	United Nations Conference on Environment and Development

WCED	World Commission on Environment and Development
WFD	Water Framework Directive

Chapter 1. Introduction: river restoration and appraisal

1.1 Introduction

Rivers and their floodplains have always been highly politicised. Over the past two centuries, rivers across the world have been straightened, dammed, diverted, culverted, encased in concrete, disconnected from their surrounding floodplains and fenced-off from their local communities. The reasons for these changes are multifaceted and vary between more developed and less-developed nations, with the former being more commonly subject to channelisation; and the latter more frequently characterised by damming or river regulation (Brookes, 1988). However, with the 'greening' of environmental policy in the late 1980s, a shift in ethos has been witnessed, moving away from technocentric, hard-engineering approaches and embracing more ecocentric, softer alternatives such as restoration. Couched in the rhetoric of sustainability, the new philosophy of restoration has had a significant impact on how rivers are managed and how local communities expect their rivers to be managed. Although practical knowledge on how to undertake river restoration projects has developed at a rapid rate, little attention has been paid to project appraisal – a process necessary for both gauging the success or failure of river restoration projects and enabling the incorporation of good practice into future schemes.

The primary aim of this thesis is to detail and evaluate the appraisal frameworks and techniques employed on river restoration projects in the UK. In this thesis appraisal is defined as 'a reflective assessment of a scheme's degree of success, given clearly defined aims and objectives' (see Bruce-Burgess, 2001a: 7; and Bruce-Burgess, 2001b: 82). This research evaluates the extent to which restoration projects have implemented the appraisal frameworks and techniques proposed in the practical restoration and policy literature, and examines barriers to the incorporation of effective appraisal into river restoration projects.

A truly inter-disciplinary approach is taken in this thesis, linking human and physical geography through a focus on the geomorphological and public appraisal techniques which form part of a holistic catchment-based approach to undertaking river restoration projects. This also requires that the decision-making structures employed on river restoration projects be explored in detail, with particular attention to the requirements of both 'scientific' and 'lay' decision makers and their influence on a project's trajectory and appraisal.

This research has been undertaken in the context of the European Community's (EC) Water Framework Directive (WFD) (Directive 2000/60/EC, see CEC., 2000) which encourages water management to be undertaken in River Basin Districts (RBDs) utilising River Basin Management Plans (RBMPs) whilst emphasising a need to achieve 'good ecological status' through the enhancement of Heavily Modified Water Bodies (HMWBs: Article 4: 24). This more holistic approach to management planning also requires public consultation (Article 14: 46), and the establishment of monitoring and surveillance programmes (Annex 5: 24) with consideration of a river's hydromorphology and ecological status.

This chapter sets the research context for this thesis. Section 1.2 discusses the practice, policy, science and philosophy of restoration by detailing the emergence of the practice of river restoration globally and nationally, whilst looking in detail at the practical reasons and political drivers behind river restoration's emergence. Section 1.3 introduces the concept of project appraisal, examining what appraisal means, why it is required and the extent of project appraisal to date. Appraisal is identified as an important yet understudied component of river restoration. This section provides a context for the remainder of the thesis which critically evaluates the incorporation of appraisal techniques and frameworks into river restoration projects in the UK as a basis for informing future policy and practice. The final section of this first chapter (Section 1.4) provides a discussion of the thesis's research aims and objectives, and identifies the contents of the following eight chapters.

1.2 The emergence of river restoration: a new approach to river management

This section considers the emergence of river restoration practically, politically, scientifically and philosophically (Section 1.2.1-1.2.4) as a redress to the impacts of river channelisation and regulation, with specific focus on the UK. In doing so it provides a background to the remainder of the thesis. Section 1.2.1 documents the transition in river management from channelisation to river restoration, looking at some of the driving forces behind this change in ethos.

1.2.1 From channelisation to restoration

Throughout the last two hundred years, population growth coupled with technological advancement has meant that more and more land across the world has been consumed by agricultural, industrial and urban expansion. The floodplains, banks and channels of most rivers in developed countries have often been the first victims of these changes. From the beginning of the nineteenth century onwards government planning departments and civil engineers have attempted to tame nature as an early response to mitigating the perceived risk of flooding. During this positivist epoch, humankind dominated nature, seeing it as manageable, predictable and obedient to human needs. Rivers did not escape this technocentric phase of highly scientised hard-engineering, and thus watercourses were channelised into concrete straightjackets in order to enhance navigation routes and water supplies; create agricultural and waste disposal drains; increase conveyance capacities in order to reduce flood risk; and facilitate floodplain development (see Brookes, 1988).

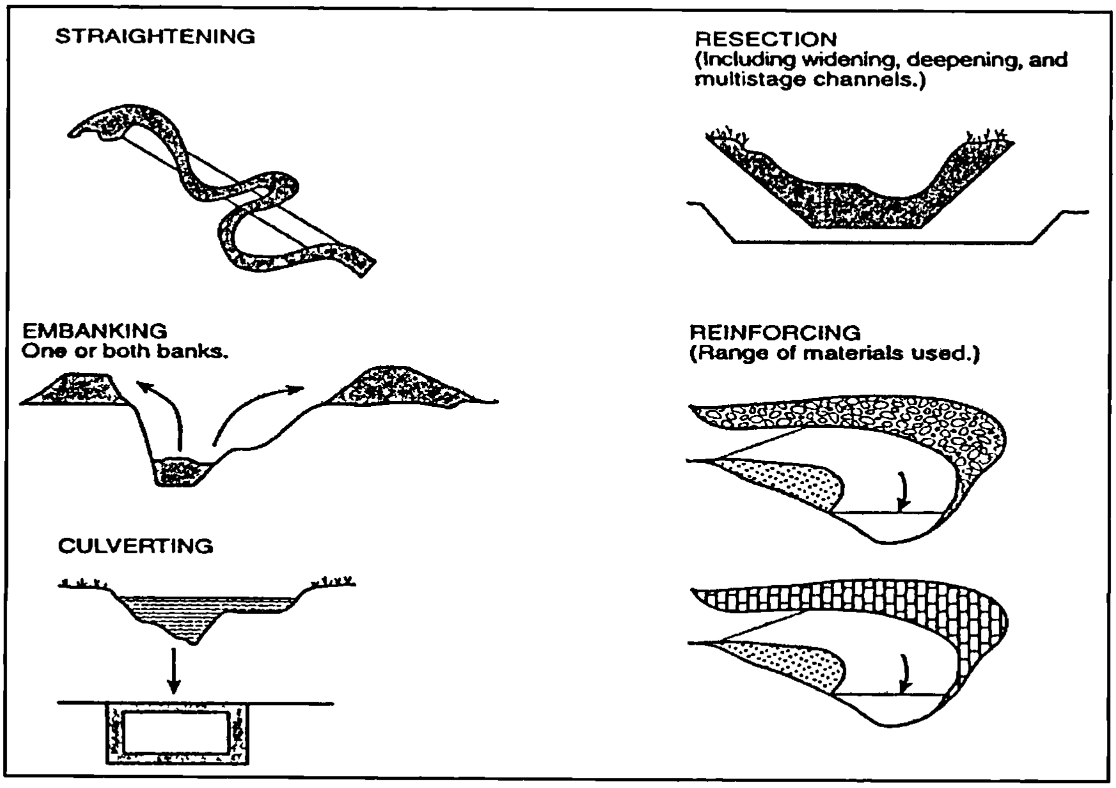
The extent of channelisation in the West has been far-reaching (see Table 1). For example, in the USA the Mississippi has been shortened by 229 km with its floodplain area reduced by 90%, and the Missouri has been shortened by 64.4 km with a total of 2111 km^2 of natural habitat lost from the channel and meander belt (Gore and Shields, 1995: 143). The range of different channelisation techniques employed in Europe is depicted in Figure 1 where direct channel modification has led to the channelisation of the majority of lowland rivers over the past 2000 years (Brookes and Shields, 1996a: 2). In Poland, the Vistula's channel width has been reduced by 50% (Brookes and Shields, 1996a: 2), and the Rhine has been largely transformed into a conduit for effluent (although the Rhine Action Program for Ecological Rehabilitation is presently reversing this). The UK has been drastically affected by channelisation works, with 80% of UK rivers estimated to have been subject to land drainage works for navigation, flood defence or agricultural purposes (Brookes, 1988: 11).

Table 1. Examples of the extent of channelisation works in the United States

Location	Extent
Missouri River	1600 km already channelised
Pennsylvania State	480 km channelised
Seven mid-western States	46,530 km already undertaken
Soil Conservation Service projects in the US	12,366 km already undertaken
Twelve south-eastern States	40,000 km planned for channelisation
Mississippi River (US Army projects)	1750 km completed
Minnesota	34,720 km in total

Source: adapted from Brookes, 1988: 10

Figure 1. Examples of conventional river channel modifications



Source: Sear *et al.*, 2000: 58

As the practice of channelisation gained momentum from the 1960s onwards, its negative consequences also began to be recognised (see Heuvelmans, 1974). This recognition occurred against the political backdrop of a growing environmental movement in the USA and the UK, and also as a response to the physical failure of hard-engineering structures such as the collapse in 1996 of a concrete flood control channel in Corte Madera Creek, California (Williams, 2001: 19). An example of this growing dissatisfaction and increased environmental mobilisation was witnessed in 1971 on the Kissimmee River (South Florida) when a grassroots pressure group emerged to promote the restoration of the river even before channelisation works had been completed (Koebel, 1995: 152). Court cases against channelisation proliferated during this period, demonstrating the growing dissatisfaction with conventional engineering techniques, for example the case of Chicod Creek (USA) (Coffey, 1982: 80-82) and also the battle for Amberley Wild Brooks (Sussex) (Brookes, 1988: 54-55). At this time it was also beginning to be realised that whilst channelisation might decrease flood defence locally it could exacerbate flood risk elsewhere, removing areas of flood storage and conveying greater volumes of water downstream. From this period onwards channelisation also began to be critiqued not only on aesthetic grounds but also for the hydrological, ecological and geomorphological degradation with which it had become associated. It was during this period that river restoration began to emerge as an alternative to channelisation and 'softer' forms of river management and engineering began to be espoused.

Having discussed the reasons for river restoration's emergence, the following section identifies some of the broad reasons why river restoration projects are undertaken. This is followed by a discussion of river restoration's adoption globally and nationally.

1.2.2 The practical emergence of river restoration

It has been seen that river restoration essentially emerged as the antithesis of channelisation projects as it focuses on improving the quality and functions of river environments (ecologically, geomorphologically and hydrologically) by removing past hard-engineering structures and restoring channel form, process and function whilst providing improved public amenity (see Table 2 for description of restoration techniques). Restoration is based on the idea that properly managed rivers, floodplains and riparian corridors have great potential as biodiversity networks, linking areas rich in biota, whilst at the same time providing areas of landscape value and amenity for the public.

Individual river restoration projects are undertaken with different contextually-specific aims and objectives in mind. Having said this, some generic reasons for undertaking river restoration projects exist, for example:

- Re-connecting rivers and their floodplains by removing concrete channels, restoring the flow regime, improving geomorphology, restoring river bed morphology and sedimentology, reconnecting rivers to their beds, and re-meandering straightened reaches;

- Increasing biodiversity benefits for flora and fauna: enhancing water quality, introducing new species, enhancing habitats and protecting existing species, leading to greater wildlife interest;
- Increasing levels of flood defence, allowing water onto floodplains to store flood waters, dissipating energy and decreasing bank erosion;
- Increasing recreational opportunities by improving access and undertaking aesthetic enhancements for a more appealing landscape;
- Recharging aquifers; and
- Reducing nutrients, with floodplain reedbeds acting as an agricultural buffer zone (adapted from Holmes, 1998a: 335).

Table 2. Examples of different river restoration techniques

1.	Non-structural:
a)	Catchment management planning;
b)	Land use change; and
c)	Species-centred restoration.
2.	Structural:
a)	Channel and in-channel;
•	Reinstatement of natural channel (pools, riffles, meanders); and
•	Alternative technology and channel design rehabilitation (multi-stage channels, berms, Embankments, by-pass and diversion channels).
b)	Bank modification:
•	Natural materials (willow and other trees, stumps and logs, and emergent vegetation); and
•	Artificial materials (geotextiles, rip-rap, blocks of unnatural stone, gabions, and deflectors).
c)	In-stream modification:
•	Substrate reinstatement (cleaning of natural gravels, physical reintroduction of substrate);
•	In-stream modifications using natural materials (debris, boulders, and channel vegetation); and
•	In-stream modifications using artificial means (current deflectors, sediment and gravel traps).
d)	Riparian zone and floodplain restoration:
•	Reinstatement of natural systems (riparian zones, floodplain restoration, livestock control); and
•	Creation of alternative systems (buffer zone strips, wetland creation and flood storage areas).

Source: for more detail see RRP, 1993: 20-58

The practice of river restoration has been rapidly adopted by Western nations. This is particularly evident through the publication of restoration manuals developed to aid practitioners in undertaking such projects (see Table 3). In particular, the USA (FISRWG, 1998; and NRC, 1992) has pioneered the adoption of restoration as alternative science, with Australia and New Zealand (Brizga and Finlayson, 2000; and Schofield *et al.*, 2000), Canada (Karr *et al.*, 2000) and many European countries (De Waal *et al.*, 1995; Iversen *et al.*, 2000; Nielsen, 1996; and RRC, 1999a) following its lead. River restoration is also gaining popularity in Central and Eastern Europe (Khaiter *et al.*, 2000), South Africa (O'Keefe and Uys, 2000), and Japan (Waley, 2000). Restoration practice differs from country to country with the USA undertaking restoration projects for the longest period of time over varying spatial and temporal scales and using a wide range of techniques (see Table 4). Many projects have also been undertaken in Australia with the development of strengths in integrated catchment management and an emphasis placed on community-based catchment-care groups such as *Waterwatch* and *Landcare* (see Johnson *et al.*, 1996; and Chalkley *et al.*, 1999).

Table 3. Restoration manuals developed by different countries

Country	Title of restoration manual	Source
USA	• Stream corridor restoration: principles, processes and practices	FISRWG, 1998
	• Restoration of aquatic ecosystems: science, technology and public policy	NRC, 1992
	• Kissimmee River Restoration Evaluation Program	SFWMD, 2002
Canada	• Ontario's stream rehabilitation manual	Ontario Streams, 2000
Australia	• A rehabilitation manual for Australian streams	Rutherfurd *et al.*, 1999
New Zealand	• New Zealand Stream Health Monitoring and Assessment Kit	Biggs *et al.*, 1998a
UK	• Manual of River Restoration Techniques	RRC, 1999a; and 2002a
Italy	• Manual of River Restoration Techniques translated into Italian for the Centro Italiano per la Riqualificazione Fluviale	2002

In Europe, individual projects have generally been on a smaller scale than the USA and Australia, between 200m-5km due to the smaller size of rivers (see De Waal *et al.*, 1995: 688). The nature of river restoration works is European Union (EU) member-state specific due to different historical causes of land degradation, different political structures and environmental priorities. In a study of 66 river and floodplain rehabilitation projects in Western Europe, De Waal *et al.* (1995: 683) found that most projects were channel-based and driven primarily by nature conservation objectives.

In the UK, the nature of restoration projects has been influenced by the country's long history of environmental change. Channelisation in the UK dates back to Roman times (Holmes, 1998a: 332) and 80% of lowland British rivers have had part of their channel modified (Raven *et al.*, 1998: x). UK restoration projects are undertaken for a variety of reasons. However, their scale is constrained like other European projects by flood defence responsibilities and issues of land ownership. Over the period 1999 to 2002 river restoration practice in the UK increased by 55.5%, from 356 projects in 1999, to a total of 800 projects in 2002 (see RRC, 2000; RRC, 2001; and Janes and Phillip, 2002: 6). This growth reflects the global development of the field of restoration, and also the adoption of river restoration as an alternative management ethos in the UK. In 1998, the UK River Restoration Centre (RRC) (previously know as the River Restoration Project, RRP) was established to act as a vehicle to demonstrate the potential of river restoration and to disseminate information and advice on river restoration. The Environment Agency (EA), Scottish Environmental Protection Agency (SEPA), and the Rivers Agency (Northern Ireland) have no statutory responsibility for river restoration, thus the RRC helped fill this void, promoting and facilitating river restoration in the UK. This institutional context is part of the emergence of river restoration as a political issue.

Table 4. Some case studies of river restoration in the US: aims and techniques

Location	Aim of the restoration	Techniques employed
Kennebec, Edwards dam, Augusta, Maine	Restore upstream fish migration mechanisms	Dam removal
Anacostia, Baltimore	Construct wetlands, improve public amenity	Use dredged sediment to construct a wetland
Glen Canyon dam, Colorado	Create seasonal flow variations akin to pre-disturbance regimes	Simulation of seasonal flow variations
Gunnison River dam, Colorado	Restore pre-dam channel geomorphology and hydrologic conditions	Alter dam operating rules
Kissimmee, Everglades, South Florida	Restore meandering course and old water levels	Re-meandering
Briar Creek, North Carolina	Produce natural looking meandering stream in an urban area	Bank stabilisation, re-vegetation, re-meander
Trinity and Lewis dam, Northern California	Improve sediment mobility, restore fishery	Alter dam operating rules
Elwha and Glines Canyon dam, Washington	Restoration of hydrologic and biotic conditions	Fish ladders, spillway modification
Rush Creek, Sierra Nevada, California	Enhance aquatic and riparian habitats, specify in-stream flows for habitats	Habitat enhancement, channel widening
Woolen Mills dam, West Bend, Milwaukee	Restoration for sports fishing, and creation of an urban park setting	Aquatic habitat enhancement

Source: adapted from Graf, 1996; Wasserman, 1997; Schmidt *et al.*, 1998; Keller and Hoffman, 1977; Kondolf, 1998a; and Kondolf 1998b

1.2.3 The political emergence of river restoration

In Western nations the turn towards environmental restoration has been initiated either to reverse past human impacts or to create new forms of nature (Reay and Norton, 1999). The rapid growth of the environmental movement throughout the twentieth and twenty-first centuries has led to a greening of environmental policy which has resulted in extensive environmental legislation concerning river management. Since its emergence, the practice of restoration has been politically embedded in the environmental policies dictated at global, international and national levels. In fact, so strong is this embeddedness that Brown (1994: 357) has suggested that restoration ecologists need to become more aware of the political and economic issues surrounding restoration projects. This move towards restoration has been driven by numerous factors. The most significant of these have been the public discontent with past technological fixes and the subsequent greening of environmental policy following the 1987 World Commission on Environment and Development (WCED), which has facilitated a move towards more sustainable futures.

Restoration, as an alternative to channelisation, embraces a complete change in ethos, seeing a move towards bioengineering techniques and a greater consideration of the role of humankind in nature. Jordan *et al.* (1987: 3-21) date the first attempts at ecological restoration to the 1920s on the prairies of the USA. However, restoration as a common approach to environmental management only really began to gain momentum in the late 1980s and early 1990s. Its relatively recent adoption coincides with the incorporation of sustainable development into environmental policy and into the vocabulary of mainstream society leading to the greater public questioning of unsustainable environmental practices. Table 5 documents the incorporation of the concept of restoration into recent environmental policy making. In these policy documents, restoration plays a key role in the achievement of sustainability aspirations (delineated in 1992 at the United Nations Conference on Environment and Development - UNCED) such as the protection of biological diversity through conservation of habitats and species, and the reparation of damaged ecosystems. *Towards Sustainability*, the European Commission's programme (CEC, 1992), also specifically emphasises the role restoration has to play in river corridor management, helping to recreate lost connections between floodplain habitats and rivers.

Despite the environmental and social benefits of undertaking restoration projects, the extent of future restoration work will be limited by the need to protect people and properties from flooding (associated with climate change and land use change effects). Thus, river restoration schemes will need to cope with likely future changes in flood frequency and intensity. It can hence be seen that although the practice of restoration has the potential to enhance the environment both physically and socially, it would not be appropriate for restoration to be applied in blanket form on all degraded rivers.

Despite the adoption of the term restoration into environmental policy, sufficient public resources are not presently in place to facilitate the practical implementation of major restoration efforts. For example, in the UK's Environment Agency (EA), there is no budget specifically set aside for river restoration, so although the desirability of restoration is acknowledged in policy this does not necessarily translate into practice. River restoration thus faces political and scientific uncertainty, hindering its adoption. However, despite restoration's acceptance globally as a redress to the environmental damages caused by channelisation it has faced much philosophical debate amongst social scientists as outlined in the following section.

Table 5. Emergence of the concept of 'restoration' in environmental policy

Name of policy	Reference to 'restoration'
Rio Declaration	'Conserve, protect and **restore** the health and integrity of the Earth's ecosystem' (UNCED, 1992a, Annex 1, Principle 7)
Agenda 21	'Promote the **rehabilitation** and **restoration** of damaged ecosystems and the recovery of threatened and endangered species' (UNCED, 1992b, Chapter 15 Section 5h)
Towards Sustainability	'Through Natura 2000 **restore** and maintain habitats and corridors between them' (CEC, 1992: 93)
Habitats Directive	'Maintain or **restore**, at favourable conservation status, natural habitats and species of wild fauna and flora of community interest' (European Commission, 1992: Article 2, Section 2)
Creating an Environmental Vision	**Restore** and protect land (EA, 2000b: 9)
Managing Natura 2000 Sites	Promote sustainability by maintaining or **restoring** certain habitats and species at 'favourable conservation status' within context of Natura 2000 sites (European Commission, 2000: 10)
Sustainable Europe for a Better World	Protect and **restore** habitats and natural systems and halt the loss of biodiversity by 2010 (CEC, 2001: 12)

1.2.4 The philosophical emergence of river restoration

The use of the term restoration has been strongly debated by social and natural scientists and practitioners alike. From these debates it has become increasingly evident that there is no general consensus within academic disciplines and environmental bodies over what the term restoration means (Clarke *et al.*, 2003). This lack of clarity has emerged from restoration's dual background in both the arts and natural sciences, emphasised by Bradshaw (1993: 71):

> 'In museums, restoration was once a great art. Yet now it is a powerful science, demanding substantial training, an understanding of materials, and the use of scientifically based techniques.'

Restoration as a term has many different meanings. Over the past two decades restoration has been defined in either a multi-functional or single-functional manner (see Table 6, Sections 1-2). Multi-functional definitions of restoration (also referred to here as complete or full restoration, see Table 6, Section 1) take a holistic and multidisciplinary stance, necessitating a structural and functional approach to restoration, including elements of geomorphology, ecology and public perception. Such strong interpretations of restoration have been made by Cairns (1991) and the NRC (1992) who see restoration as a means of turning back the clock to a pre-

Table 6. Definitions of restoration (incorporating strong and weak interpretations), and alternatives to restoration

Strong

1. Multifunctional/complete restoration:

- Complete structural and functional return to a pre-disturbance state (Cairns, 1991)
- The way to repair the damage (Kentula, 1997)
- Prompted recovery (Downs and Thorne, 1998)
- Multi-nature-style river planning (Waley, 2000)

2. Single-functional restoration:

- Creative ecology (Berger, 1991)
    - Creative conservation (Adams, 1996)
- Nudging nature (Hawkins *et al.*, 1999)
- Repairing damage caused by humans to the diversity and dynamics of indigenous ecosystems (Jackson *et al.*, 1995)

Weak

3. Alternatives to restoration:

Amelioration	Creation	Enhancement	Mitigation	Natural recovery	Naturalisation
Reclamation	Recovery	Recovery enhancement	Re-establishment	Rehabilitation	Reinstatement

Sources: Brookes and Shields, 1996a; Eden *et al.*, 1999; Gore, 1985; NRC, 1992; and Sear, 1994 disturbance state. Such a goal may not be possible according to Wasserman (1997: 4) as the restoration of historical conditions would mean reversing all human-induced changes, thus the pre-disturbance condition (as a snapshot in time) may either be no longer sustainable or may not be representative. This pre-disturbance utopian goal has hence been replaced by single-function restoration and terms such as 'prompted recovery' (Downs and Thorne, 1998: 20), 'nudging nature' (Hawkins *et al.*, 1999: 23) or a 'healing technology for environmental management' (Eden, 2002: 318), all of which aim to reverse damage faster than if nature was left to its own devices (Gunn, 1991). With all of these there is the implication that natural change will produce a river that is in balance with current catchment conditions.

Single-function restoration has also replaced multi-functional restoration in practice. Multi-functional river restoration is seen as being a holistic, multidisciplinary, multi-stakeholder and catchment-based approach to river restoration. Although such integrated approaches are highly desirable (see Brookes and Shields, 1996b: 389-393), they have rarely been practised due to the complexities of catchment-scale approaches (Brookes and Shields, 1996a: 11) and the temporal, financial and institutional constraints which projects operate under. As a result, single-functional definitions and applications of restoration (see Table 6, Section 2) have been more commonly applied. These interpretations of the term restoration are generally focused on the restoration of one aspect of an entire system. For example, Goodwin *et al.* (1997) and Schmidt *et al.* (1998) have focused solely on the ecological components of a reach instead of the geomorphological (see Graf, 1996) or water quality components (see Herricks and Osborne, 1985). At its extreme this single-functional approach can be seen to favour restoration for the benefit of a sole taxonomic group (Clarke *et al.*, 2003; and Brookes and Shields, 1996a: 11). Clearly these two extremes of restoration both have their place and their application must be context specific. However, it is the case that full restoration is increasingly seen as a 'visionary target' by academics and practitioners which is not always possible (Holmes, 1998b).

A single definition of what restoration is does not exist as restoration means different things to different people and organisations. As a result of this alternatives to the term restoration emerge both in the literature (Table 6, Section 3) and on the ground. These alternatives acknowledge that the complete structural and functional mimicry of a pre-disturbance state is rarely possible and often not desirable (Downs and Thorne, 2000; Katz, 1992; Tapsell, 1995; and Wasserman, 1997). For example, on the Snowy River (Australia) restoration of the pre-dam scenario was neither possible nor desirable because the conditions below the dam had stabilised themselves to a new regime (see Erskine *et al.*, 1999). Moreover, lack of pre-disturbance data often precludes strong interpretations of restoration. Also local stakeholder groups frequently favour other more manicured alternatives to full restoration, thus, according to Brookes and Shields (1996a: 11), restoration for aesthetic reasons may be equally valid in urban environments (see Keller and Hoffman, 1977). Numerous terms are now employed interchangeably. The existence of alternative terms such as 'rehabilitation' or 'creative conservation' implies recognition in the environmental sciences that although restoration is a desirable goal, it is often too hard to achieve, or in many cases impossible. The UK RRC sees restoration as a visionary target 'of pristine rivers that are wholly returned to an undisturbed state requiring no management' (Holmes, 1998b: 139). This definition sees restoration as an ideal with 'rehabilitation' as a more practical alternative. Naturalisation, as proposed by Brookes and Shields (1996b: 2-5, see also Graf, 2001), may be the most feasible alternative to restoration, as it considers ecological and geomorphological processes holistically whilst taking into account the human influences within the catchment.

The term restoration can be used as a visionary target at the start of projects by enabling environmental managers to refer back to a river's past physical and ecological structure. It can also help in the development of future goals of how they wish the river to look and perform. In some instances a multi-functional understanding of restoration will be employed, in other instances it will be single-functional. Whatever the extent of restoration desired for a project, a suite of aims and objectives is required in order to assess whether restoration has been achieved or not. This assessment is the process of project appraisal.

It has been seen that restoration has multiple meanings, and because of the contested nature of the term restoration different people want and expect different things from restoration projects. For example, on a restoration project an environmental manager's perception as to how a project should be undertaken and whether a project is deemed to be a success once completed will be influenced by their understanding of the term restoration. Similarly, another environmental manager engaged in the same project may have a different understanding of the term restoration and hence their perception of whether a project is a success or not may differ from that of the first environmental manager. It can therefore be seen that there is a link between the contested meanings of restoration and project appraisal: how one interprets the term restoration influences one's ability to decide whether a project has been a success or not.

The following section examines project appraisal as a tool for planning, guiding and evaluating river restoration projects, providing a context for the remainder of the thesis. Appraisal is a much understudied component of river restoration and is made all the more interesting by the fact that different people have different understandings of what river restoration comprises, and different expectations given their own personal and disciplinary backgrounds. Scientific and lay communities also have different understandings of what restoration means. The following section defines both the meaning of appraisal and why it is needed. This provides a context for Chapter 2 where different appraisal frameworks and techniques are reviewed and a framework of how appraisals should be undertaken is composed against which river restoration projects can be evaluated.

1.3 River restoration project appraisal

To date, project appraisal has been a much understudied and a rarely undertaken component of river restoration projects. In the USA 'there's been no critical appraisal of river restoration techniques' (Matt Kondolf, Personal Communication, 20/10/2000). Also in the UK, Holmes (1991: 7) has noted that out of 100 enhancement projects carried out by the National Rivers Authority (NRA) in the 1980s only five had had any form of post-project appraisal. It will be seen that appraisal, like restoration, has numerous contested definitions and there exists conflicting opinions as to what appraisal comprises.

1.3.1 Defining project appraisal

The concept of environmental appraisal takes its derivation from Environmental Impact Assessment (EIA) which originated in 1969 in the USA through the National Environmental Policy Act, requiring that all major federal projects be subject to an assessment of their likely environmental impact (Graf, 1992: 15). In 1985 the EU followed suit with the formulation of the EIA Directive (85/337/EEC). Despite these advancements in policy, in the UK water industry EIA is only required on restoration schemes which are part of a capital flood defence projects (Gardiner, 1992: 165); (in the UK EIA is also referred to as environmental assessment, and both terms will be used interchangeably throughout this thesis). This lack of statutory requirement for appraisal has meant that an increasing number and a wide variety of different appraisal techniques have been developed and used on restoration projects in order to demonstrate their environmental effects (these will be discussed in detail in Chapter 2). Like the term restoration, appraisal has numerous definitions. For example, it has been defined as:

- 'a generic term for the evaluation of the environmental implications of proposals' (DOE, 1993: 55) as;
- 'the process of defining objectives, examining options and weighing up the costs and benefits before a decision is made' (HMSO, 1991: 39); and
- 'a generic term relating to the identification, measurement and assessment of environmental impact' (Ministry of Agriculture Food and Fisheries: MAFF, 2000: 8).

However, in specific reference to river restoration, Gardiner (1990, Part 2: 2) has defined appraisal as 'the entire process from project definition to detailed design.' A broad understanding of what appraisal means (akin to Gardiner's definition) is adopted in this thesis. Appraisal is defined here as 'a reflective assessment of a scheme's degree of success, given clearly defined aims and objectives' (Bruce-Burgess, 2001a: 7; and Bruce-Burgess, 2001b: 82). The use of this definition is favoured here as unlike the other definitions it sees appraisal as an on-going (from project inception through to post-project appraisal) and continually reflective process, in which a project's success or failure can be gauged by comparing a project's original aims and goals to post-project parameters.

Table 7 indicates that within the field of river restoration, the term 'appraisal' is most frequently used and applied by UK practitioners with 'evaluation' being favoured in the USA and Australia. Here the term appraisal is favoured as this thesis focuses on the UK context where the term has been used historically by practitioners and academics alike. In this thesis evaluation is seen as a component of appraisal rather than an alternative definition of appraisal (see Brookes, 1988: 64). 'Assessment' and 'monitoring' (see United Nations, 1984: 13 for a definition of monitoring) are also seen in this thesis to be components of the appraisal process and not as alternatives to the term appraisal.

Table 7. Definition of appraisal and its alternatives

Term used:	Dictionary definition	Where used:
Appraise(al)	• Estimate the value or quality of • Formal evaluation of performance	• UK (Brookes and Gregory, 1988; Downs and Skinner 2000 and Gardiner, 1991)
Assess(ment)	• Estimate size, quality or value of	(no references found)
Evaluate(ion)	• Assess, appraise • Find/state the number or amount of	• US (FISRWG, 1998 and Kondolf, 1998) • Australia (Rutherfurd *et al.*, 1999)
Monitor(ing)	• Devise for checking/warning about a situation • Maintain regular surveillance over	• McDowell (2001)

Source: Ninth Edition of the Concise Oxford dictionary, COD9, CD Rom Version

1.3.2 Defining the need for project appraisal

Understanding appraisal has the potential to enhance the manner in which projects are planned and executed. Appraisal is also important because it enables one to learn from current projects, ensuring that the same mistakes are not replicated, whilst enabling successes to be incorporated into new projects (Nolan and Guthrie, 1998: 686). Despite these facts the literature suggests that appraisal has been rarely undertaken for three reasons:

1. There exists a fear of disclosing project failure due to the stigma attached (Kondolf, 1995a: 107), despite the fact that there is a clear necessity to understand why problems were encountered in order to not make the same mistakes *ad infinitum* (Brookes *et al.*, 1998: 25);
2. It has been seen in the USA and UK that a preference exists for funding further practical projects rather than studies and appraisals (Kondolf, 1998a: 465); and
3. It is often assumed that any river restoration work must be positive because it is restoring a degraded system (Kondolf, 1998a: 466). However, post-project appraisal is rarely undertaken to substantiate this assumption. For example, Kellar and Hoffman (1997: 240) state that stream restoration is 'clearly better than doing nothing.' However, they cannot substantiate this assumption as there have been too few appraisals to provide proof.

In the UK, the practical implementation of appraisal is currently obstructed by the nature of funding for river restoration projects. Since no money is available for the appraisal of river restoration activity, many small-scale projects are undertaken reactively (e.g. as part of flood defence projects, see Clarke and Wharton, 2000: 2). This thesis will look at the influence of project funding on project appraisal in order to establish factors which drive and constrain projects. Due to the reactive nature of project funding the literature suggests that many projects are rarely returned to for post-project appraisal aside from a simple visual appraisal. Even on larger schemes it is rare for appraisal to be a properly costed component. For example, on the £100m Jubilee Flood Defence project (Maidenhead, UK), Alastair Driver (Personal Communication, 21/02/2001) reported that 'there isn't actually a penny available on this scheme for monitoring.' This thesis will explore these assertions in order to examine the factors which constrain project appraisal. From the environmental management literature it is evident in the UK as in the USA that funding bodies would prefer to see money spent on bigger projects rather than focusing on appraising completed projects to ascertain whether they have achieved their original aims or even whether they have had negative impacts. This will also be examined.

The present lack of focus on appraisal causes reason for concern, as Beschta *et al.* (1994), Frissell and Nawa (1992) and Kondolf *et al.* (1996) have identified (using post-project appraisal) negative impacts associated with restoration projects. During an examination of the incidence and causes of physical failure of 161 artificial fish habitat structures in 15 streams in Western Oregon and Washington, Frissel and Nawa (1992: 182) found a median failure rate of 18.5% and a median damage rate of 60% (see Tables 8 to 9). They also found that most structures which had a life expectancy of 25 years usually failed before the age of 20. Whilst during an evaluation of the performance of a salmon spawning rehabilitation project on the Merced River (California), Kondolf *et al.* (1996: 899) found equally unpromising results. Project failure was linked to a poor understanding of geomorphologic processes whereby designs were often based on folklore as opposed to a clearly and rationally planned design. For example, the logic behind the site's selection was not justified in the planning documents, and also the designs did not demonstrate any analysis of geomorphic processes such as erosion and sediment transport, and assumed that boulders would hold gravel in place (Kondolf *et al.*, 1996: 906). House (1996: 279), on the other hand, undertook an appraisal of stream restoration structures in East Fork Lobster Creek (Oregon) and found that fish numbers had increased, and that physical structures stayed in place remaining fully functional and culminating in an increase in summer rearing habitat.

These examples highlight the importance of appraisal, as it can identify both failures and successes, enabling one to learn from one's project, and thus advance both the science and practice of restoration. These lessons learnt can then be fed into new projects and into a system of adaptive management to benefit future projects.

Table 8. Examples and causes of physical failure of artificial fish habitat structures in Western Oregon and Washington

Name of site	Impact
Northern California	Reduced trout abundance in a stream with artificial boulder structures compared to an unaltered reach
Fish Creek, Western Oregon	Large-scale habitat modification program, improved fish habitat but had negative/neutral effect on boulder berms and log structures. Some structures were damaged by floods before they could affect physical or biological conditions
Idaho	Little evidence that in-stream structures increased abundance of salmon, on one project 20% structures failed in first winter
Big Creek, Utah	Artificial structure were destroyed by trampling and grazing of cattle
Colorado	Three quarters of structures failed or rendered ineffective by floods two years after construction, remaining structures barred migrating fish

Source: Frissell and Nawa, 1992: 183

Table 9. Damage and failure rate on streams of Western Oregon and Washington

Southwest Oregon	Damage rate (%)	Failure rate (%)	Southwest Washington	Damage rate (%)	Failure rate (%)
Bear Creek	79	32	Rush Creek	22	11
Foster Creek	27	7	Falls Creek	0	0
Silver Creek	50	17	Layout Creek	89	11
Shasta Costa Creek	83	55	Upper Trout Creek	42	0
Euchre Creek	100	95	Lower Trout Creek	40	0
Crooked Bridge Creek	100	100	Wind River	70	0
"Outcrop Creek"	40	40	Trapper Creek	60	20
Boulder Creek	60	40			

Source: adapted from Frissell and Nawa, 1992: 186

1.4 Conclusion: aims and objectives of thesis and outline of chapters

This chapter has set the research context through a general discussion of the practice, policy, science and philosophy of restoration. It has provided a background to the emergence of the practice of river restoration both across the world and in the UK. The practical reasons why restoration has emerged and the political drivers behind river restoration have been identified. The meaning of 'restoration' has been discussed, examining the various alternatives to restoration (e.g. enhancement and rehabilitation). It was shown that whilst the term 'restoration' is hotly contested it can be used to represent an 'ideal' or a 'vision' of a status desired for rivers if no financial and practical constraints existed.

These discussions were then followed by an introduction to river restoration project appraisal, examining what appraisal means, why it is required and sketching out the extent of project appraisal to date. It was identified that much like the term restoration, the meaning of appraisal is also contested. Appraisal was shown to be central to the undertaking of restoration projects as it acts as a logical framework within which to plan and implement projects. Additionally, although the importance of project appraisal is acknowledged in the literature it has been a much understudied and rarely undertaken component of river restoration projects.

Overall, this thesis argues that the science and practice of river restoration would be improved if appraisal became a standard and central component of restoration projects. The specific aims and objectives of this research are identified in the following section.

1.4.1 Research aims and objectives

Research aim. The overall aim of this thesis is to critically evaluate the incorporation of appraisal techniques and frameworks into river restoration projects in the UK as a basis for informing future policy and practice. This evaluation of the appraisal of river restoration is undertaken at two different spatial scales – nationally and regionally. The national investigation (Chapter 4) is designed to be extensive and aims to draw out the basic dimensions of river restoration projects and their appraisal in the UK. The regional investigation (Chapters 5 to 7) is, in contrast intensive, adopting a case study approach which examines in detail how appraisal has and has not been implemented. These two scales of investigation have the following ancillary aims:

The national investigation involves establishing the nature and range of UK restoration projects and their associated appraisal procedures undertaken to date (research undertaken between October 1999 and October 2002). The forms of appraisal used in these restoration projects are then evaluated against the appraisal techniques and frameworks recommended in the practical restoration and policy literature. Within this evaluation public participation and geomorphological appraisal are seen as key to project success (see Chapter 2), and these two forms of appraisal are focused on in most detail throughout this thesis. This investigation also identifies the constraints to undertaking project appraisals in practice and the barriers to incorporating the appraisal frameworks and techniques proposed in the literature.

The regional investigation involves the detailed examination of how appraisal has been incorporated into three river restoration projects in the Thames Region of the EA, and also identifies the barriers to undertaking project appraisals. The practical application of different appraisal frameworks and techniques and their associated decision-making structures are evaluated. This involves understanding the stages and components of the appraisal frameworks and the constraints and benefits of the different appraisal frameworks and techniques utilised. This investigation evaluates the extent to which river restoration projects are undertaken within a structured framework of appraisal and incorporates techniques and frameworks proposed in policy and practical restoration literature. Particular emphasis is placed upon the use of geomorphological and public appraisal techniques.

The involvement of different stakeholder groups in decision-making and the structure of these decision-making processes will also be examined. This will enable an assessment of the extent to which different disciplinary and institutional background appear to influence a project's appraisal framework and trajectory. Additionally, the differences between 'scientific' and 'lay' knowledge will also be explored.

This investigation also identifies the barriers to incorporating effective appraisal frameworks and appraisal techniques into river restoration projects. The aim is to highlight potential solutions, changes and recommendations to the science and practice of restoration, which will in turn encourage a more effective incorporation of appraisal into restoration projects. These recommendations are then utilised to propose changes to the appraisal frameworks proposed in the literature, helping to guide future restoration projects.

The following two sections identify the contents of the chapters which set out the national and regional investigations.

1.4.2 National investigation into river restoration project appraisal procedures

Chapter 2. Literature Review: appraisal structures, frameworks and techniques comprehensively reviews the literature on appraisal. This chapter examines different appraisal frameworks and techniques (geomorphological and public participation) which have been proposed theoretically and applied practically, and impediments to undertaking appraisal are also highlighted. By drawing on the practical restoration and environmental management literature a framework of how appraisal should ideally be undertaken is put forward. This model of appraisal is then used throughout the thesis to evaluate the appraisal frameworks and techniques which are used in practice in the UK. This model is returned too and critiqued in the concluding chapter of the thesis proposing practical changes to this structure based on lessons learnt from the projects examined in this thesis.

Chapter 3. Research Methodology: a multi-method approach details the research techniques which were used to collect and analyse the data for both the national and regional investigation. A multi-method approach is used here combining quantitative and qualitative research methodologies. These methodologies are discussed theoretically and practically. The latter discusses the selection of quantitative data collection techniques for the national investigation and qualitative techniques for the regional investigation. The quantitative survey provides a detailed numerical account of the extent of appraisal in the UK and the appraisal techniques utilised. It is complemented by the qualitative investigation which provides a descriptive account and explanation of the process of project appraisal and the associated process of environmental decision-making in a limited number of case studies. Selection of the UK (for the national investigation) and the decision to focus on the Thames region (for the regional investigation) are justified in this chapter, as are the selection of the three case study sites. The logistics of both investigations are also discussed (e.g. sampling frames, questionnaire creation, and the development of interview schedules), also the data analysis techniques employed are described and explained.

Chapter 4. National investigation: river restoration appraisal techniques. This chapter details the environmental policy framework within the UK, and discusses the changes to the water resource sector post-UNCED and the arrival of river restoration practice. The structural make-up of the EA is then discussed, and the differences between the EA's regions (politically and physically) are examined providing a context to the national investigation of appraisal procedures, and enabling an understanding of the different policies and constraints within each region. Data collected by the RRC and the data gained from the national investigation are analysed and discussed through use of descriptive statistics, alongside qualitative data gained through personal communication or as text derived from questionnaire responses. This investigation evaluates the appraisal frameworks and techniques employed against those proposed in Chapter 2. This evaluation is undertaken within the context of the UK as a whole and also at the regional level, allowing for inter-regional comparisons of policy and practice. Barriers to undertaking both river restoration projects and appraisal are highlighted. This national investigation of river restoration appraisal provides the context for the second part of the thesis which evaluates in depth the incorporation of appraisal in river restoration projects within one EA region (Thames).

1.4.3 Regional investigation into river restoration project appraisal procedures

Chapters 5 to 7 evaluate the practice of river restoration through the analysis of environmental policy and practice at the regional scale (within the Thames region of the EA). Three very different Thames region case studies are focused on: two completed restoration projects (one rural, the other urban) and one which is on-going (rural, chalk stream). This case study approach enables an exploration of the issues faced by urban, rural and chalk streams, with the on-going project providing insight into the dynamism of consultation procedures and decision-making processes.

Chapter 5. Thames Region Investigation: evaluating river restoration decision-making structures. This chapter sets the Thames region of the EA within its local policy context, exploring the practice of river restoration and appraisal. This chapter also adds context to the Thames region results of the national investigation which are discussed in the context of the region's policies. It also provides background information on each case study in terms of its catchment, site and decision-making structures. The primary focus of this chapter is the decision-making structures employed on these three projects, arguing that the decision-making structures utilised can have as great an influence on a project as the appraisal framework utilised, influencing both a project's appraisal and its trajectory. This chapter also sets the scene for the next two chapters which examine the appraisal techniques and frameworks employed on the case study projects.

Chapter 6. Thames region investigation: evaluating river restoration appraisal structures examines the different appraisal structures employed on the three case studies, and the subsequent influence of these on each project's final design and trajectory. This chapter draws on qualitative data collected from interviews, policy documents and archive material. The interviews were undertaken with environmental managers engaged in river restoration projects who provided detailed accounts of project appraisals they had been involved in. This chapter describes the different appraisal structures employed, and evaluates them against the appraisal framework proposed in Chapter 2.

Chapter 7. Thames Region Investigation: evaluating the impacts of decision-making and appraisal structures upon river restoration project design and implementation assimilates the findings of Chapters 5 and 6 and evaluates the efficacy of the decision-making structures, appraisal structures and appraisal techniques employed on the three case studies in relation to the appraisal framework proposed in Chapter 2. This evaluation enables a thorough examination of the effects of the decision-making structures on appraisal and appraisal on decision making. From this evaluation are drawn theoretical and practical conclusions which are fed into the final chapter.

Chapter 8. Conclusion draws together key empirical, theoretical and practical findings from the national and regional investigations. This chapter is divided into two parts. The first part is both empirical and theoretical and commences by discussing the results of this research. These results are then used to evaluate how effectively UK river restoration projects incorporate the appraisal frameworks and techniques proposed in the literature. Barriers to project appraisal are identified and ways forward to circumvent these obstacles are proposed. The second part of this chapter is more practical. The appraisal framework proposed in Chapter 2 is revisited and is critiqued in conjunction with the results of Chapters 5 to 7. This framework is further evaluated in the light of a workshop on river restoration appraisal with river restoration practitioners (November 2002). On the basis of this workshop possible appraisal frameworks are discussed and ways of including appraisals in river restoration projects are put forward.

Chapter 2. Literature Review: appraisal structures, frameworks and techniques

2.1 Introduction

River restoration project appraisal is not required by law in the UK. As a result, approaches to project appraisal have been wide ranging with a variety of appraisal techniques and frameworks having been developed. In some cases approaches to appraisal have been multi-disciplinary and formed part of the project from its start through to completion. In other cases appraisals have been single-disciplinary and undertaken at only one phase of a project. This chapter reviews the literature on project appraisal, first describing the origins of project appraisal and then outlining the different appraisal frameworks created.

The chapter first delineates the main component parts of project appraisal. It argues that river restoration project appraisal should include three specific components to enhance a project's long-term sustainability in both environmental and social terms. The first component of river restoration project appraisal is that it needs to commence at a catchment level to facilitate the selection of an appropriate site for restoration. The second component of appraisal proposed here is the need for the inclusion of geomorphology in project appraisal. This is required at both the catchment and reach level to ensure that the site selected for restoration will not have a negative geomorphological effect on sites downstream. Thirdly, catchment- and reach-level appraisal of public perceptions is required for the development of restoration projects which not only enhance the environment but are also acceptable to local communities and the local authorities within which they are undertaken. These three components are fully examined prior to a discussion of the similarities between project appraisal and EIA. Following this discussion of appraisal frameworks, the different appraisal techniques utilised on restoration projects are described. These techniques are understood here as the specific tools utilised by practitioners as part of an appraisal framework. The purpose of this discussion is to set out some of the most frequently applied approaches and techniques used in project appraisal in order to provide a background understanding of these techniques (necessary for the discussions in Chapters 4 to 7) and their associated advantages and disadvantages.

This chapter concludes with the development – from the literature discussed in Sections 2.1 and 2.2 – of an ideal-type appraisal framework which is used throughout the thesis as a tool against which to evaluate how river restoration projects have been and are currently appraised in the UK. This framework is developed because this chapter indicates that whilst there are many appraisal techniques and frameworks available in the literature – particularly single-disciplinary appraisal techniques – none provide comprehensive guidance on how project appraisal should be undertaken from a project's start through to completion. The framework developed provides a guide to project appraisal from site selection through to post-project appraisal incorporating from the literature discussed throughout this chapter.

2.1.1 Primary components of appraisal

This section examines the three primary components of project appraisal for river restoration described above. The first is the selection of sites and the creation of restoration projects at the catchment level. This enables projects to be selected and developed so that they are appropriate for the catchment in question and are therefore sustainable at the reach and catchment scale. This is in keeping with the second component of appraisal which is the need for geomorphological appraisal. Geomorphological appraisal is important not only because it can facilitate the selection of the most suitable sites for restoration but also because it can enable the creation of projects which will be sustainable in the long-term without destabilising sites downstream. The third component of project appraisal is public appraisal. This is as important as the other components in the sense that a site's selection and a project's design will only be as successful as its end-use and future adoption by the local community. Hence it is important to create projects which are sustainable both socially and physically, as without public acceptance then the project's long-term future could be jeopardised. These components have emerged from the literature as important elements of river restoration and project appraisal, they are now discussed in greater detail and their incorporation in river restoration projects is tested throughout the remainder of thesis.

(i) Catchment based appraisal

It is argued here that river restoration project appraisal needs to commence at a catchment level. Fluvial systems are integrated, and restoration of isolated sites without consideration of the catchment context can affect a project's long-term viability. Additionally, catchment-level appraisal satisfies the WFD which will utilise RBDs as the units within which the aquatic environment is managed. At the catchment level areas of watercourses that need restoring can be identified, as the WFD will place an emphasis on the identification of HMWBs and sites of good ecological status. This form of classification will draw out sites which need restoring, and by viewing these sites within their catchment context environmental managers will be able to make decisions about how best to restore them. By viewing a degraded site within the context of its surrounding catchment the environmental manager may be able to understand the causes of degradation and suitable solutions. For example, a blockage upstream of the restoration reach may be starving the site of sediment, altering geomorphological processes; or an industrial unit upstream may be polluting the restoration reach. Identifying issues such as these at an early stage is important in achieving restoration projects' goals.

In implementing the WFD the UK EA is developing RBMPs. These plans may also be consulted by environmental managers during early stages of project appraisal in order to select sites for restoration which may also serve as sites where flood waters could be stored during critical storm events. These sites would thus have not only environmental benefits but would also assist in alleviating flooding, thus having dual environmental and social benefit to the catchment's community. Project appraisal should thus commence at the catchment level in order to ensure that projects are developed to fit in with extant policies and catchment level goals, and also to ensure that the causes of degradation and the consequences of restoration are viewed within their wider context and that their upstream and downstream effects are anticipated.

(ii) Geomorphological appraisal

The second component of appraisal proposed here is the need for the inclusion of geomorphology in project appraisal. This is required at both the catchment and reach level, and acts as a template for the development of projects which are sustainable both geomorphologically and ecologically. Geomorphological appraisal, if undertaken at a catchment-based level, can help identify the reasons why the reach being restored exhibits its present physical characteristics. For example, at a catchment level one can identify sources of sediment and zones of sediment transfer and deposition. This can help the environmental manager understand why, for example, a reach looks and functions the way its does. Also, at a catchment level one can identify any structures which may be affecting the reach's geomorphological regime. For example, the presence of upstream barriers such as weirs or channel constrictions such as bridges may affect the transport and deposition of sediment at the restoration reach and hence will have a strong influence on its geomorphological structure. In addition to the river-channel interactions, the river's interaction with its floodplain is also important. If upstream reaches are dislocated from their floodplains through canalisation or extensive urbanisation then sediment deposition may be restricted at these locations, and these sediments may be washed down and deposited in the restoration reach. In developing geomorphological goals for a reach it is thus important to anticipate how the river's geomorphology upstream will affect the project reach.

Geomorphological appraisal at the catchment level can help develop appropriate goals for the restoration reach which take account of the project's upstream and downstream impacts. Also, a comprehension of the catchment's geomorphological behaviour can help in the development of restoration goals for a site. At the project level, knowing how more or less degraded reaches in the catchment perform geomorphologically can assist in the development of appropriate geomorphological goals through usage of a reference reach system. Reference reaches can assist environmental managers in comprehending the types of geomorphological features (e.g. pool-riffle systems, sediment size) that are exhibited in less degraded sites. Geomorphological appraisal at the catchment and reach level also ensures that a project's goals and a project's structure are developed so as not have negative downstream effects, for example to avoid increases in flood risk and to avoid degrading a river's ecological and amenity potential.

Geomorphological appraisal is important because if it is undertaken in sufficient depth it can facilitate geomorphological restoration which has the potential to restore the connections between rivers and their floodplains. This has dual benefits to a catchment and reach's ecology and hydrology. Geomorphological restoration recreates lost ecological niches within the channel as sediments provide homes for macroinvertebrates and macrophytes, whilst the restoration of pool-riffle sequences and bank-side cliffs provide suitable environments for fish spawning. The river-floodplain interaction recreates lost wetland habitats which support flora and fauna and re-link watercourses providing riparian corridors which facilitate the dispersal of seeds and animals and provide amenity and recreation opportunities for humans.

One of the main goals of river restoration projects is to enhance biological diversity through the recreation of specific habitats in order to assist in the achievement of the UK's Biodiversity Action Plan (BAP) targets. In addition, 'Living organisms reflect most directly the integrity and supportive capacities of ecosystems' (Everard and Powell, 2002: 332) and are thus a useful indicator of a project's success or failure. It is being increasingly acknowledged in the field of river restoration that the single-disciplinary approaches adopted in the past which focused solely on ecological restoration do not facilitate the restoration of sustainable systems. A move towards eco-geomorphologically designed projects is now more prevalent recognising that the geomorphological structure of a river underpins habitat heterogeneity and overall levels of biodiversity. This point is reiterated by Kondolf (1995b), Briggs (1999), Gilvear (1999) and Newson and Newson (2000) who all see geomorphology as the framework or template upon which habitats develop, hence physical structure can be used as a surrogate indicator of biodiversity (Raven *et al.*, 2000: 359).

Although the importance of the role of geomorphology has not been fully advocated in environmental policy, the recent WFD is set to change this trend. The WFD emphasises the role of hydro-morphology in striving to achieve 'good ecological status', linking a river's hydro-morphological character to the survival and reproduction of biota (Foster *et al.*, 2001: 9). Sear *et al.* (2001) have also discovered that truly eco-geomorphological restoration offers biodiversity benefits not only within channel but also at the catchment level. Consideration of the geomorphological processes operating within a catchment can help to ensure that restoration projects are sustainable in the future (Wade *et al.*, 1998: 2). Geomorphological appraisal ensures that habitats are not created and later destroyed by geomorphological processes that had not been anticipated (e.g. the upstream release of a sediment slug through increased erosion). According to Newson and Sear (2000: 2), a consideration of geomorphology adds an element of sustainability to river management as it requires managers to first of all consider the river in its catchment context prior to designing and implementing a project. This provides a clear framework for structuring appraisal. The fields of ecology and geomorphology combined provide a wide range of appraisal tools for planning, executing and appraising river restoration projects which will be discussed in section 2.2.

Geomorphological restoration can also affect the hydrological regime of watercourses by re-making connections between a river and its floodplain, with the latter providing flood storage areas for times of high flow. If restoration is undertaken at the headwaters of rivers it has the effect of mitigating flooding in downstream reaches which are often the worst hit during storm events. The need to achieve this is ever more pressing as the effects of climatic change and urbanisation are increasing peak flows throughout catchments. Geomorphological restoration of reaches through the introduction of gravels and more sinuous planforms and cross-sections can also increase the hydraulic roughness of channels. These structural changes can dissipate peak flows compared to trapezoidal concrete channels which exacerbate flood risk downstream by providing free and unhindered passage to flood flows. Geomorphological restoration is usually coupled with ecological restoration through the recreation of river-floodplain linkage, providing additional attenuation of flood flows as heavy rainfall is absorbed by vegetation. This is in line with the EA's floodplain policy (http://www.environment-agency.gov.uk/commondata/105385/126710.pdf) which seeks to restore the reconnection of rivers with their floodplains so that they can be used to store the increased flows which are an anticipated consequence of climatic change.

(iii) Public appraisal

Thirdly, catchment- and reach-level appraisal of public perceptions is required for the development of restoration projects which not only enhance the environment but also are acceptable to local communities and the local authorities within which they are undertaken. If projects are undertaken without regard to the local public then their long-term adoption may be thwarted and their potential environmental, hydrological and public benefits will not be achieved. The importance of public appraisal and consultation is additionally highlighted in the WFD whereby goals for RBD will be established through direct liaison with community groups. Public appraisal is therefore not only important in its own right but also within policy. Like geomorphological appraisal, public appraisal is required at both the catchment- and reach-level as the type of project undertaken at the reach level should be driven by goals and requirements at the catchment level. Catchment-level policies such as Local Authority Unitary Development Plans should help to drive reach-based restoration schemes, as these policies will identify local level goals and requirements for green spaces within the catchment. Also, the nature of the catchment, be it heavily urbanised, rural or a mix of both, will influence the nature of the restoration project to be undertaken. For example, in a highly urban catchment the creation of a project which enhances amenity and recreation may be desired. However, risks such as health and safety and flooding may restrict the geographical extent or scope of the restoration project in terms of its design. In rural catchments, land-ownership may restrict where restoration projects may be undertaken. However, restoration projects in these locations may have the greater potential to provide biodiversity gain. Restoration projects exhibit a combination of environmental and social goals at the catchment scale.

Public participation is one of Agenda 21's core principles and also forms part of the WFD (CEC 2000, Article 14: 46). Its inclusion within river restoration projects is thus imperative for undertaking projects successfully as stakeholder participation throughout a project can ensure that projects are undertaken to achieve environmental goals whilst also benefiting local communities. The public also increasingly see rivers as landscapes, hydrosystems and ecosystems worthy of preservation and restoration (Graf, 2001: 1). The development of adequate tools for appraising public opinion is thus of great importance for influencing a project's design and long-term success and hence forms a vital component of an appraisal framework. In Section 2.2.2 the participation of the public as an environmental actor in river restoration projects is examined, briefly considering the range of public appraisal techniques which have been utilised in terms of the degree to which they are consultative and participatory, or both.

Public appraisal should also form an important component of river restoration projects because these projects are often undertaken on publicly-owned land such as parks or on land where the public have rights of way, for example in city centres or alongside farm land. Watercourses in these locations are important to members of the public because they see and interact with them on a daily basis, hence their consultation on how best to manage them is very important. The public often have strong opinions on what features they wish to see restored on the reach in question and their extensive local knowledge can thus help to develop projects which will be accepted and used by the local community. Lay knowledge can provide a great deal of insight into a local environment. For example, during public consultation work in Manchester, Mark Turner of the Mersey Basin Campaign found great value in consulting local dog-walkers along a stretch of river. During this consultation he found that one dog-walker kept a diary of his walks and through consultation of this diary the Mersey Basin Campaign were able to locate and rectify a local source of water pollution (Mark Turner, Personal Communication, 2002). This example demonstrates the fact that some members of the public can have a more intimate local knowledge of their environment than the experts. In addition, river restoration projects are usually funded by public money, hence it is important to demonstrate that this money has been well spent.

Public involvement in restoration projects can also help to educate local communities into adopting more environmentally-sound practices in their everyday lives. Rivers are also good educational resources for local schools and colleges. For example, as part of the River Brent restoration project members of the EA took local children for a walk around their catchment and these children helped environmental managers place stickers on surface water drains (Susie Tudge, Environment Agency, Personal Communication, 2003). The purpose of this was to educate local communities into understanding the fact that drains discharge into local watercourses, hence people should be mindful of what they dispose of down these drains as they may pollute their local river.

Public consultation is important in the creation of a project which achieves not only its environmental goals (e.g. ecological and geomorphological restoration), but also achieves social improvements which add a resource to the local community. A well-designed project can offer a wide range of benefits to end-user groups especially in locations where green space is limited. Consulting local people can ensure that an environmental resource is created which best serves their needs. For example, on the River Skerne in Darlington the local community requested that the river restoration project incorporated a circular walkway around the river and that paths were created to facilitate wheelchair access. Although these would appear to be simple requests the precise siting and design of these features required the input of local people (Deirdre Murphy, Personal Communication, 2000).

Community participation at an early stage and throughout a project assists not only in the project's design but it also creates a sense of ownership within the local community. This is important as it enables the environmental manager to get local people on board at an early stage to become involved in the long-term monitoring of restoration projects as volunteers (Williams, 2002: 315). In Australia 'WaterWatch' groups made up of local communities monitor their local watercourse as a form of neighbourhood watch (Chalkley *et al.,* 1999). This approach has also been adopted recently on the canals of East London whereby volunteer wardens patrol the watercourses on a daily basis monitoring activities such as fly-tipping and taking note of any positive or negative impacts on the environment. The public thus form an invaluable component of decision making, as they get involved in project design and assist in the creation of a sense of public ownership which can reduce the chances of a restoration project being vandalised. Although public consultation is an important component of environmental decision making it is also vital that those undertaking the consultation are aware that public opinion can also be biased and based upon particular vested interests (e.g. fishing). Hence when appraising local opinion it is important to consult a wide cross-section of the community to ensure that all voices are heard and their needs incorporated.

This highlights that one of the main difficulties in public perception work is defining who is included in this all-encompassing group called 'the public.' Frequently the term 'the public' is used as if they were an homogeneous and easily identifiable entity. However, in reality they comprise a diverse group of people with divergent views (Tunstall *et al.*, 2000a: 4). The public is composed of members of different ages, economic status, employment status, gender, level of education, physical/mental health and social class. There are multiple publics, and according to Tunstall *et al.* (2000b: 363) the public – as individuals and as a group – attaches great importance to being consulted. This fact complicates the design and implementation of river restoration projects, as identifying and appraising the local public's perceptions for inclusion in projects is an expensive and time-consuming process (Tunstall *et al.*, 2000a: 8). However, if people's views are not appraised then strong feelings of contention are likely, and also important facts may remain obscured if a purely scientific appraisal is relied upon. For example, if public perception work had not been undertaken on the River Brent (North London) it would not have been realised that the river divided two distinctly different communities (in terms of class) who were very apprehensive about the prospect of being united through river restoration (Tunstall, 2001). The added danger inherent in umbrella terminology such as 'the public' is the increased risk of excluding certain groups whose voices are not as strong as others, such as ethnic minority groups, children, the elderly, and people with disabilities. Public appraisal techniques need to be aware of the risks of exclusion and to develop methods which are as inclusive as possible. It is also important to respect those who (for whatever reason) do not want to participate. Harrison *et al.* (1987: 348) warn that the vast majority of any community is likely to made up of non-participants.

This section has discussed the three components of appraisal – the catchment scale, geomorphology and public participation – which are focused upon throughout this thesis and sets out the reasons why these components are important to both river restoration and river restoration project appraisal. The following section considers the appraisal frameworks and techniques proposed in the literature. This is then followed by the delineation of an appraisal framework against which project appraisal is evaluated throughout the thesis.

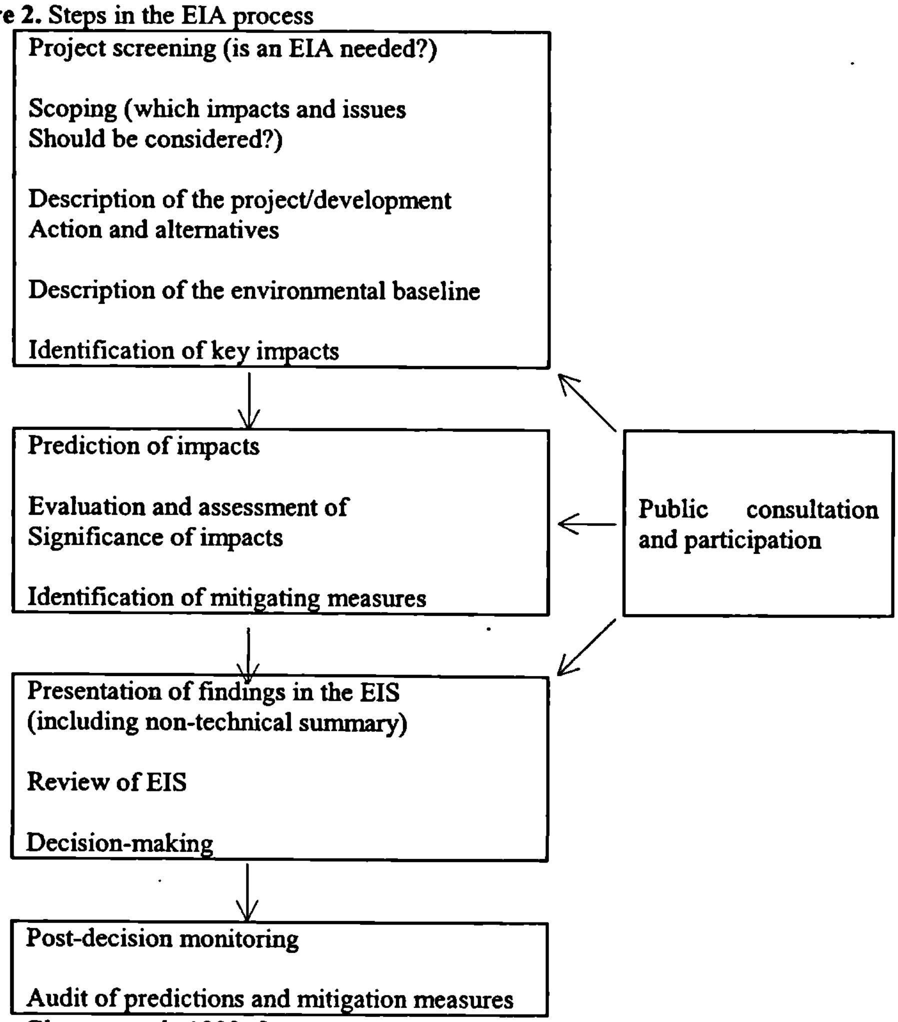
2.1.3 A review of appraisal frameworks

This section explores different appraisal frameworks discussed in the literature which have been or could potentially be used in the context of river restoration. First of all, EIA frameworks are explored. This is then followed by a discussion of appraisal frameworks which have been developed in the water management literature. The suitability of these approaches for appraising river restoration projects is discussed in the light of the three components of appraisal which were identified in Section 2.1.1.

EIA began to be employed in the USA over 25 years ago and was first applied in the UK in 1985 through the European EIA Directive 85/337/EEC (Glasson *et al.,* 1999). EIA Directive 97/11/EC superseded this 1985 Directive and requires EIAs to be undertaken before planning consent can be granted for major development projects which are believed to have environmental impacts (DETR, 1999: 5). EIA acts as a procedure for 'drawing together, in a systematic way, an assessment of a project's likely significant environmental effects' (DETR, 1999: 7), whilst also giving due consideration to social and economic factors. EIAs have been generally utilised in land use planning for single developments which are considered to constitute 'major' projects (Glasson *et al.,* 1999: 140) and are thus likely to have significant environmental impacts. EIAs are submitted in conjunction with planning applications for major projects. Planning application consultees (e.g. local authorities; the EA; and, depending on the nature of the site, English Nature and RSPB) respond to different sections of EIAs highlighting elements which need more thorough attention. For example, the EA is a statutory planning consultee on planning applications which fall within flood plains, and in circumstances where there is a risk of flooding the EA may identify the need for a Flood Risk Assessment to be undertaken in line with the requirements PPG25 (OPDM, 2001). For developments which may affect the status of a Site of Special Scientific Interest (SSSI) English Nature may require that more detailed ecological surveys are undertaken. Aside from identifying risks, EIAs can also enable consultees to place planning conditions on proposals in order to minimise the effects of the proposal upon the consultees' statutory interests.

According to Glasson (1999: 5-6), EIA follows fifteen distinct steps as shown in Figure 2. EIA commences with a phase of project screening. This is a process whereby projects are scrutinised in order to identify the projects or elements of a project which will have the most significant environmental impacts. This is akin to the phase of site selection which begins most river restoration projects, whereby a site is selected from a catchment level appraisal of potential restoration sites.

Figure 2. Steps in the EIA process



Source: Glasson *et al.*, 1999: 5

EIA then embarks upon a process of project scoping, identifying impacts which are the most significant in terms of their environmental impacts and hence need to be addressed. At this stage it is also ensured that all alternatives have been examined, for example, with regards to factors such as location, scale, processes, layouts, conditions (physical and social) and areas which require 'no action'. This also has similarities to project appraisal, whereby options are considered such as 'do nothing' and the elements which require restoration are identified.

EIA then clarifies the purpose and rationale of the project, highlighting goals and anticipated outcomes, and identifies the present (pre-project) and future (post-project) state of environment. This is the same as appraisal in that the aims and objectives of a project need to be clearly identified and quantified, with data collected at an early stage so that the achievement of these goals can be appraised at the post-project stage.

EIA returns to the above steps in order to ensure that all significant impacts (environmental and social; and adverse and beneficial) have been considered. This is then followed by a prediction of impacts which identifies the magnitude and dimensions of identified change in the environment if action is taken or not taken. This is similar to the phases of river restoration appraisal whereby different options are developed and appraised prior to selection.

EIA then evaluates and predicts the impacts of possible options and introduces mitigation measures to remedy/reduce adverse environmental impacts. This is different to river restoration project appraisal as river restoration projects are undertaken to restore a section of degraded river therefore there is not a need to mitigate adverse environmental impacts as it is assumed that the restoration work will be an improvement. EIAs are generally undertaken on projects which are likely to have adverse impacts and therefore these impacts need to be mitigated and the least environmentally-damaging option selected.

In EIA public consultation is undertaken prior to the development of an Environmental Impact Statements (EIS) which presents the impacts derived from previous steps in the process, identifies goals, impacts and measures to reduce impacts. In river restoration project appraisal, public consultation should ideally occur at an earlier stage than that proposed in EIA in order to develop goals for a project and identify any potential constraints.

The EIS is then appraised systematically and responses to public consultation are considered in the selection of a preferable course of action which is least environmentally damaging and fits with the requirements of the public and decision makers. This phase has similarities to river restoration appraisal. However, river restoration is much more specific and, depending upon the site in question, also uses other forms of appraisal (e.g. geomorphological appraisal).

The final phase of EIA is post-decision monitoring which records the outcomes associated with development impacts, compares actual outcomes with predicted outcomes, assesses quality of predictions and effectiveness of mitigation. This is similar to post-project appraisal which compares a river restoration project's outcomes against the project's goals.

River restoration project appraisal is a long-term process which can be undertaken over a period of years, whereas EIA is a one-off process. Immediate post-project appraisal is not the end of river restoration post-project appraisal as long-term site management feeds into a project by appraising its success and leading to alterations through adaptive management.

It can be seen that EIA acts as a means of identifying projects which are likely to have significant environmental impacts. Once the environmental impacts of these projects have been identified the EIA procedure enables mitigation measures to be developed to remove or reduce these impacts. The systematic nature of the EIA ensures that baselines are established at an early stage so that the impacts of a project can be assessed by comparison of the actual and predicted outcomes. EIA also includes a step devoted to public consultation. The results of this step are drawn together in a phase of decision making which combines all environmental, social and economic factors.

The precise nature and structure of EIA varies from study to study and between countries, and is generically a useful tool for developing projects and identifying the environmental problems and means of mitigating them. Although EIA as a framework has many similarities to river restoration project appraisal frameworks (as discussed above) it may not be wholly applicable to the appraisal of river restoration projects as it does not provide the specific detail which is required to appraise those projects.

According to Gardiner (1992), a catchment approach to environmental assessment is necessary when making decisions about the management of the water environment. This is in keeping with the first component of environmental appraisal discussed earlier. The notion of a catchment-based appraisal is not incorporated into EIA and is one reason why EIA is not wholly suitable as a framework within which to undertake river restoration project appraisals.

Furthermore, in Section 2.1.1 the concept of undertaking geomorphological appraisal at the catchment and project level was identified as a prerequisite of restoration project appraisal. EIA is a very broad appraisal framework as it is utilised for a wide range of environmental projects. This means that it does not provide sufficient specific detail for fully appraising all types of project. This is especially true of river restoration projects where geomorphological appraisal is needed at the catchment and reach level to develop an appropriate project for the reach in question. Also, in river restoration specific elements – for example, sediment size – need to be appraised in greater detail. River restoration appraisal frameworks need to be much– more specific than EIA frameworks at the level of particular detail and content.

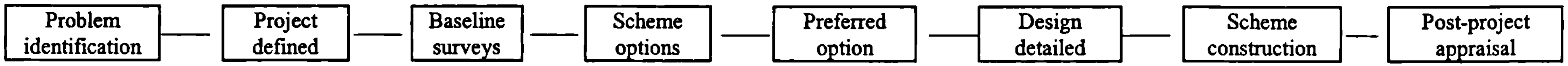
Like the components identified in Section 2.1.1 EIA does identify the need for public appraisal. However, in EIA public appraisal is identified low down the list of requirements. On restoration projects public consultation and appraisal are identified as a continuous process undertaken at the catchment scale and also at the project level. On river restoration projects, public appraisal should ideally be an in-depth and continuous process, whereas an EIA is a one-off process. In EIA the purpose of public appraisal is not to help develop the project but to appraise options. Ideally, in river restoration early public appraisal should aid in the development of a project so that it is sustainable environmentally and socially. This is why public appraisal is needed throughout the project.

Gardiner (1992: 165; and 1996: 51) has identified some of the above mentioned weaknesses of EIA when applied to the management of the water environment and saw the need to link EIA more closely to catchment management plans. This approach emanated from Gardiner's manual of holistic appraisal which had a firm basis in EIA procedure (see Figure 3) yet focused specifically on river management. Although Gardiner's framework showed great similarity to the structure of EIA (Figure 2) his approach differed for several reasons. Whereas EIA is generically applied to single development projects, Gardiner's (1991) appraisal guidance focused specifically on the long-term management of the river environment emphasising the need to situate river management decision making within the catchment context. In addition, whereas EIA is utilised primarily on major development projects, Gardiner's approach is not scale specific and can be applied to a range of scales, from the reach through to the catchment scale.

Gardiner's appraisal manual also gives advice on all possible components which need to be considered during river management projects (e.g. ecological appraisal, public appraisal, consideration of landscaping). As a result, this approach has benefits over EIA as it is tailored specifically to river management projects. However, despite this more specific focus on river management its focus still appears to be too broad for its sole employment on river restoration projects, as river restoration projects are but one form of 'river management'. There is therefore a need to develop an appraisal framework specifically for river restoration projects. Although Gardiner's approach broadly identifies the need for projects to be situated within their catchment context it does not provide the necessary link between geomorphological and public appraisal in the delineation and creation of projects which are designed and driven by these criteria.

At the same time that Gardiner was developing his guidance, Brookes (1988) identified different approaches to river channel management (Figure 4). These approaches describe the differences between traditional hard-engineering approaches (Figure 4, section a) and more holistic approaches to river management, and document the move towards more environmentally-sensitive forms of river management (Figure 4, section b). In Section c of Figure 4 Brookes highlights the fact that, in its transition towards more environmentally-aligned river management, project appraisal was once seen as a small component of river management but today appraisal is seen as underlying every step of river management. Thus the final section of Brookes' model provides a similar layout to that established by Gardiner.

Figure 3. Project appraisal

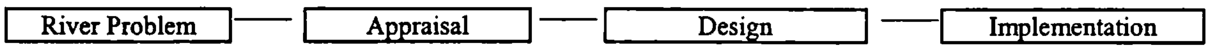


Source: Gardiner, 1991: 8

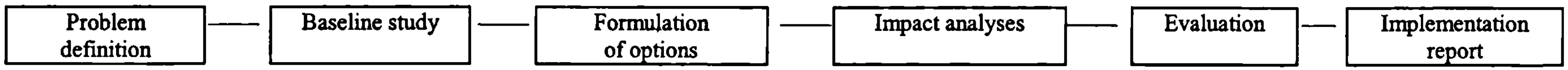
Figure 4. Approaches to channel management

a) Traditional route

b) Holistic approach



c) Stages in appraisal process



Source: Brookes, 1988: 64

EIA does not therefore provide the specific tools required to appraise river restoration projects as it is a generic assessment of the environment and does not focus on features such as a river's ecological or geomorphological composition nor its local community, all of which are important in the restoration of sustainable systems. Although Gardiner's (1992 and 1996) and Brookes's (1988) models provide more detail than EIA they still focus too broadly on river management rather than river restoration. As seen earlier, river restoration projects require the utilisation of a specific set of tools throughout to facilitate the development of projects which are appropriate for the catchment and reach in question, enabling projects to be developed which are environmentally sustainable and socially acceptable thus engendering a sense of local ownership. In the light of more contemporary research which will now be discussed it will be seen that Gardiner's and Brookes's models lack detail in the following areas: site selection; project scale; development of aims, goals and visions; selection of pre- and post-project appraisal sampling strategies; selection of control sites; and the delineation of end-points. These specific details are important in the development of river restoration projects which are both environmentally and socially sustainable.

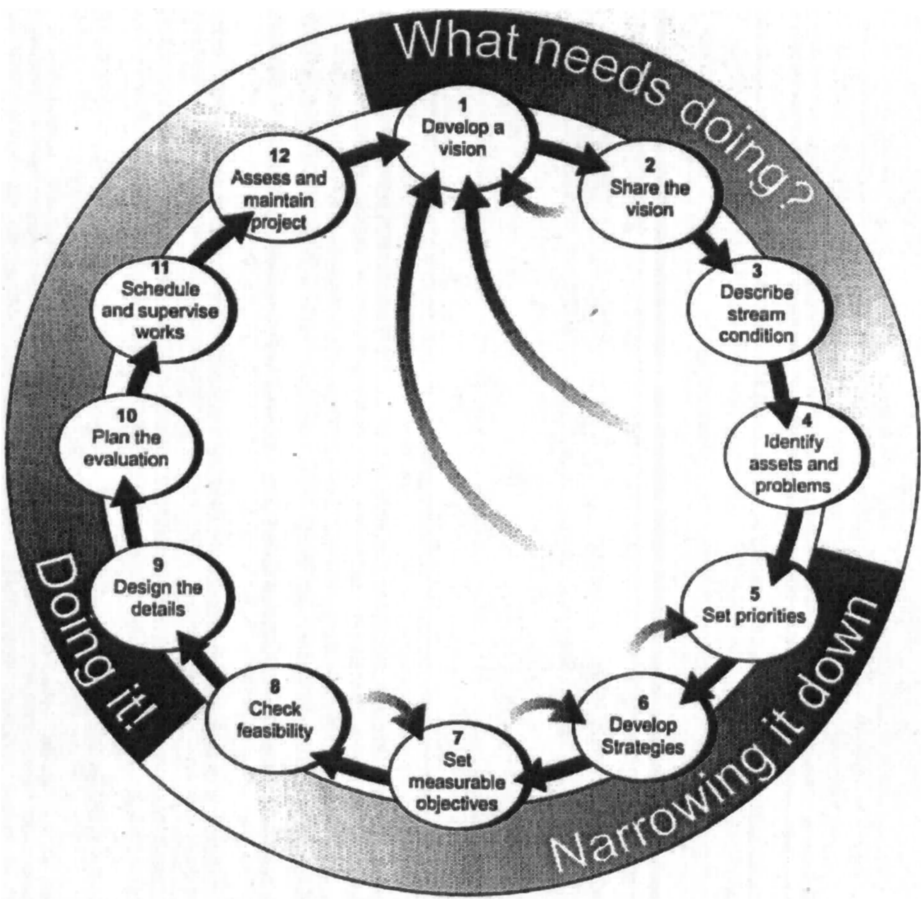
Since Gardiner published his guidance in 1992 several river restoration manuals have been produced to help guide the planning of river restoration projects. The most widely used of these manuals are:

- The US National Research Council's *Restoration of Aquatic Ecosystems: Science, Technology and Public Policy* (NRC, 1992);
- The US Federal Interagency Stream Restoration Working Group's (FISRWG, 1998) *Stream Corridor Restoration: Principles, Processes and Practice*; and
- *Rehabilitation Manual for Australian Streams* (Rutherfurd *et al.*, 1999: Volumes 1 and 2).

These documents are considered here to examine how far they provide a framework for the appraisal of UK river restoration projects.

The NRC's (1992) and the FISRWG's (1998) manuals provide two of the most comprehensive guides to undertaking river restoration written to date. However, both only cover appraisal briefly and do not provide enough structure to guide project appraisals in their entirety. These two documents focus in greater detail on specific river restoration techniques rather than on project appraisal. For example, they may discuss specific materials which one could use to restore an eroding river bank, or they may identify specific techniques for creating habitat for fish. These guides do not, however, advise the river manager how best to *identify* an appropriate course of action to restore a specific reach. Although these guides do provide advice on geomorphological and public appraisal techniques they do not identify appraisal as a fundamental component of a river restoration project from the start through to post-project appraisal. Guidance on developing and defining appropriate goals for the restoration project in question are hinted at, yet the importance of linking reach-level decisions to the catchment context is not underlined. Rutherfurd *et al's* (1999) Australian manual goes into much greater depth on all components of river restoration, describing appraisal (referred to in Australia as 'evaluation') as a fundamental component of the entire restoration process. A twelve-stepped approach to rehabilitation is proposed in this manual (see Figure 5), and great emphasis is placed on project evaluation to help determine 'systematically and objectively the relevance, efficiency, effectiveness and impact of activities in the light of their objectives' (Rutherfurd *et al.* (1999: 14). This approach offers the most detailed appraisal framework developed thus far in the literature.

Figure 5. Flow chart summarising the Australian 12-step stream rehabilitation procedure



Source: Rutherfurd *et al.,* 1999, Volume 2: 68

Despite the benefits of this approach, its complete and unaltered application in the UK context may not be wholly appropriate, due to the very different approaches to environmental management in Australia and the UK, and the differing nature of the rivers in these two contexts. For example, the regulatory framework within which this approach was developed differs greatly to the UK context, although it is likely that constraints to undertaking appraisals do exist in Australia, project evaluation appears to be more readily undertaken there than in the UK, possibly due to different environmental policy requirements. In the UK, statutory bodies (e.g. EA and EN) possess limited financial resources for undertaking restoration projects, hence project appraisals are rarely undertaken as money is available for undertaking projects but not for their post-project appraisal. In Australia, a greater emphasis on catchment-based river basin management has been evident for a longer period than the UK hence project evaluations which feed the results of projects back to community groups are more prevalent. Additionally, the ideas proposed by Rutherfurd *et al.* (1999) in Figure 5 were developed specifically for Australian rivers. UK rivers have been degraded over a greater length of time and possess different environmental and socio-cultural constraints than Australian rivers limiting the usefulness of the Australian model in the UK. Therefore, it is necessary to construct a framework for UK river restoration project appraisal which draws upon the appraisal frameworks described so far. This appraisal framework would need, however, to differ from these frameworks by entering into greater depth on all stages of the appraisal and to propose appraisal techniques as tools for undertaking the various components of the appraisal, with specific focus on the catchment (as the context for appraisal) including geomorphologial and public appraisal.

2.1.4 Summary

This section has explored different appraisal frameworks discussed in the literature. EIA was examined and but it was shown that this framework is not wholly transferable for appraising river restoration projects despite similarities to river restoration appraisal frameworks shown in the literature. This discussion was then followed by a discussion of appraisal frameworks which have been developed in the water management literature. The suitability of these approaches for appraising river restoration projects were discussed in the light of the three components of appraisal which were identified earlier.

Section 2.2 now explores the range of appraisal techniques which have been developed as tools to be part of an overall appraisal framework. These are the tools which need to be utilised at various stages in an appraisal framework. Geomorphological and public appraisal techniques are focused on as these are argued to be fundamental in the creation of projects which are environmentally and socially sustainable. In Section 2.3 components of the appraisal frameworks discussed above and the techniques delineated in section 2.2 are drawn together in the creation of an ideal-type appraisal framework for UK river restoration projects. This model appraisal framework is necessary because EIA does not provide the depth required to appraise restoration projects, and the guidance on appraisal provided so far focuses on river management as opposed to river restoration. This framework will draw together the three components of appraisal which were identified at the start of this chapter and will be used in this thesis as a tool against which to evaluate the present nature of project appraisal in the UK.

2.2 Appraisal: techniques for restoration

This section explores the different appraisal techniques which have been developed and employed within the appraisal frameworks set out in Section 2.1. The purpose of this is to delineate the types of appraisal techniques which are available to practitioners as tools for undertaking an overall project appraisal from start to finish. The techniques discussed in this chapter will be returned to throughout the thesis, first in Chapter 4 when the different numbers and types of appraisal techniques undertaken on UK river restoration project are documented, and again in Chapters 5 to 7 when the appraisal frameworks and techniques applied on three case studies are explored. The following section provides an evaluation of these different techniques so that their pros and cons are highlighted prior to Chapters 4 to 7.

The wide range of appraisal techniques to be discussed emanate from a range disciplinary backgrounds. These techniques form part of a toolbox from which they can be selected and utilised within an appraisal framework. In practice some tools are more widely used by practitioners than others; some techniques are proposed in the literature yet rarely employed due to financial or temporal constraints or a lack of training (e.g. Fluvial Audits).

In section 2.1.1 it was proposed that project appraisal should be catchment based and should include geomorphological and public appraisal. The following discussion focuses on appraisal tools which contain these three components. The pros and cons of these different techniques are explored and their potential usage as part of an appraisal framework are is discussed. Ecological and geomorphological elements are discussed together since the two are closely interrelated. The restoration of an appropriate geomorphological structure for a reach of a river will affect an environmental manager's success at restoring a stream's ecology and both will affect the watercourse's hydrological regime. The appraisal technique(s) selected in any particular instance will also be highly dependent upon the nature of the river restoration project being undertaken. In each case, these techniques can be selected and employed as part of an appraisal framework. For example, an ecological appraisal technique could be selected as a tool for undertaking an appraisal of a reach's ecology prior to undertaking a restoration project. Or a catchment-based appraisal tool could be utilised when selecting a suitable restoration reach. These techniques are viewed as tools which can be selected and utilised as part of the appraisal framework which will be put forward in section 2.3.

2.2.1 Eco-geomorphological appraisal techniques

Geomorphological and ecological appraisal techniques have some similarities. Classification and reconnaissance as forms of appraisal are first explored. Classification techniques are discussed in the context of their usage as site selection tools, and reconnaissance techniques are discussed as means of collecting ecological and geomorphological data at the pre-project stage to assist in the design and the later post-project appraisal of restoration projects. Following these discussions, additional geomorphological and ecological appraisal techniques are explored under the title of predictive appraisals as they seek to use data collected to predict likely environmental outcomes of decision-making. Throughout this section the reasons why a practitioner may employ certain techniques are identified and the advantages and disadvantages of different techniques are explored. This toolbox of techniques is returned to in section 2.3 when an appraisal framework is developed, and some of these tools are used as examples to show how they may be applied at certain stages in that framework.

River Classification techniques. The concept of river classification has been developed to help understand the structure and processes of fluvial systems (for a review of classification systems see Naiman *et al*, 1992; and Rosgen, 1994), but it can be used as a strategic appraisal tool. River classification divides a river's reaches into classes based on their ecological structure and geomorphological form and process. The main attraction of classification as an appraisal tool is its simplicity, as it enables reaches to be prioritised for restoration based on degrees of degradation (Kondolf, 1995b: 136), and also enables benchmark or reference reaches to be selected for later usage during a post-project appraisal.

Classification possesses both advantages and disadvantages in the context of river restoration appraisal. On the one hand, it provides a fast and user-friendly approach for ascertaining a river's likely behaviour and characteristics, but on the other hand it disguises individual intricacies and quirks as channels can easily be put into the incorrect class if they do not seem to conform to the classification (Kondolf, 1995b: 134). Moreover, different people may place the same channels into different classes by virtue of their own preconceived ideas and academic training. River classification also has limitations because rivers are by nature continuous (see Vannote *et al.*, 1980), hence classifications automatically impose false boundaries on unbounded systems (Cushing *et al.*, 1983; and Gurnell *et al.*, 1994: 220). The usage of the Rosgen classification on rivers outside of the USA has also been highly criticised on the grounds that a very different range of river types exist in the USA compared to other countries, thus this classification system is not wholly applicable to rivers elsewhere. For example, lowland rivers of the UK would differ greatly from many American lowland rivers in terms of their size, hydrological regime and morphological structure (Miller and Ritter, 1996). Despite these shortcomings, classification systems still appeal to ecologists, geomorphologists and non-specialist practitioners, as they reduce the complexities inherent in environmental systems, and facilitate the formulation of management decisions (Downs, 1995: 347).

Due to their simplicity and rapidity, classification systems have thus been widely applied by river restoration practitioners. Table 10 – a presentation of ecologically-based appraisal techniques —– lists the River Habitat Survey (RHS) as a form of classification as it provides a basis for determining a river's physical character in order to assess its overall habitat quality (Raven *et al.*, 2000: 359). RHS data can be used as a benchmark against which to compare the habitat quality of modified reaches enabling one to prioritise sites for restoration

Table 10. Ecologically-based appraisal techniques

Title of appraisal technique	Description	Where used	Reference
a) Classification:			
Index of Stream Condition	Assist broad scale management of waterways providing an integrated measure of their condition	Australia, Victoria	Ladson *et al.*, 1999a; and Ladson and White, 2000
RHS	To classify rivers nationally based on habitat quality	UK	Raven *et al.*, 1997; Raven *et al.*, 1998; and Raven *et al.*, 2000
SERCON 1 and 2	Identification of rivers for conservation and monitoring of river rehabilitation schemes	UK	Boon *et al.*, 1997; Boon, 2000; and Boon, 2001
b) Reconnaissance:			
Visual estimation of fish abundance and habitat area	To estimate total areas of habitat type and total fish abundance in small streams	Canada	Hankin and Reeves, 1988
Environmental Monitoring and Assessment Program	Standard method of stream habitat data collection	USA	Kauffman *et al.*, 1999; and McDowell, 2001
c) Predictive appraisal			
HABSCORE	Assesses a river's habitat quality by prediction of Salmonid populations	UK	Raven *et al.*, 1997: 231
PHABSIM	Assess change in physical habitat (depth, velocity and cover/substrate) with changes in flow regime, or channel morphology	Germany, Finland, France, New Zealand, Norway, South Africa, UK and USA	Elliot *et al.*, 1999; Ghanem *et al.*, 1996; Gore *et al.*, 1998; Hardy, 1996; Maddock, 1999; Poole *et al.*, 1997; and Stalnaker *et al.*, 1995
RIVPACS	RIVPACS examines the association between invertebrate communities and environmental features, used to predict the likely location of aquatic invertebrates given a range of environmental factors	UK	Raven *et al.*, 1997: 217
River Styles framework	Links channel morphology to habitat as a basis for habitat assessment at smaller scales	Australia, New South Wales	Bryierley and Fryirs, 2000

based upon a site's habitat quality. RHS data are collated into a national GIS database and by referring back to this database once a restoration project is completed it is possible to appraise a completed project against sites of high habitat quality, thus measuring the likely impacts of river management activities.

Although the RHS approach is beneficial in that it enables reaches throughout the UK to be classified and compared against each other it does have its limitations when utilised for appraising river restoration projects. For example, when compared to a site of high habitat quality the restored reach may still appear to have low to average habitat quality. This result could be perceived negatively and would not give a true indication of the extent of ecological improvements which have been achieved. One of the strengths of RHS is that it treats geomorphology and ecology as linked in the creation of sites of high habitat quality rather than classifying sites solely on their ecological communities. RHS provides a wealth of information on geomorphology and ecology which can be used as benchmark or reference sites in ecological pre- and post-project appraisals. In the North West region of the EA RHS has been used as a tool for selecting sites for restoration based upon their habitat quality. This fits in with the goals of the WFD whereby sites of good ecological status and HMWBs will be identified within catchments in order to prioritise sites for restoration or preservation (see Diamond *et al.*, 2001). The usage of RHS as a catchment-level appraisal tool covers the first component of appraisal identified at the start of this chapter where the importance of selecting sites based upon their catchment context was highlighted. Thus RHS can be used as a site selection tool within an appraisal framework by helping to select suitable sites for restoration.

Another form of classification in Table 10 is the Australian Index of stream condition (Ladson *et al.*, 1999a; and Ladson and White, 2000), which like RHS creates an index of a stream's ecological condition. Streams throughout Victoria have been indexed according to their ecological status and this was then utilised as a tool for delineating areas of watercourses which require management. The SERCON (System for Evaluating Rivers for Conservation) is a similar tool utilised in the UK which uses RHS data to identify sites for conservation as part of a GIS-based database. This approach reiterates the importance of selecting and siting river management activities within their catchment contexts.

Geomorphological classification techniques are listed in Table 11. Watershed Ranking for Rehabilitation (utilised in New Mexico) and the Geomorphological Sensitivity Assessment provide a means of classifying watercourses in order to facilitate the selection of a site at the catchment scale. The latter assesses how geomorphologically sensitive a reach may be to changes in management activity which may affect the sediment dynamics of the river catchment in question. This allows management activities to be altered so as to influence the rehabilitation of degraded reaches without detrimentally affecting a reach's geomorphology.

Table 11. Geomorphological appraisal techniques

Title of appraisal technique	Description	Where used	Reference
a) Classification			
Watershed ranking for Rehabilitation	Watershed ranking of rehabilitation	New Mexico, River Zuni	Gellis *et al.*, 2001
Classification of natural Rivers	Engineering; fish habitat enhancement; restoration and water resource management	USA	Rosgen, 1994; and Rosgen 1996
Geomorphological Sensitivity Assessment	Appraisal of geomorphology at catchment scale as input to CMPs to assist in planning, management by providing a rapid assessment	UK	Brookes, 1995
Catchment Baseline Studies	Over view of geomorphological state of a river and its conservation value	UK	EA, 1998b
b) Reconnaissance			
Stream reconnaissance	Assess conservation value of a river: qualitative information and quantitative data; stream classification; engineering geomorphological analysis of streams; field identification of instability; supplying input to stable channel designs; assessment modelling	UK, River Blackwater	Downs and Thorne, 1996; Thorne *et al.*, 1996; and Thorne, 1998
c) Predictive appraisal			
River Channel Typology	Describes and records morphological characteristics in relation to fluvial and sedimentary processes. Predicts channel dynamism, evolutionary trends and sensitivity to impacts	UK	Clarke *et al.*, 1995; Newson *et al.*, 1998; and NRA, 1992b
Fluvial Audit	Determines the catchment factors which are important in influencing the fluvial geomorphology of a project reach by building on data collected during Catchment Baseline Survey	UK	EA, 1998b; and Sear *et al.*, 1995
Geomorphological Dynamics Assessment	Quantitative analysis of channel in problem reach assessing morphology, geomorphological processes, process-form links and sensitivity to change	UK	EA, 1998b
Geomorphological Assessment	Provides overview of: river's current condition, physical characteristics of catchment	UK, River Ravensbourne	Babtie, 2000

Generally, classification is a useful appraisal tool as it can help environmental managers in their selection of sites for restoration. However, the classification technique employed needs to take account of the wider socio-political context of the catchment when selecting a site for restoration. In 1998 *River Geomorphology: a Practical Guide* (EA, 1998b) was developed by applied geomorphologists for use by the EA. This document recognises the role that geomorphology has to play in project appraisal and assists in the planning and design of river restoration projects. This manual helps one choose *where* to restore, and gives advice on *what* to restore in terms of fluvial features (Newson and Sear, 2000: 2). The first stage of appraisal proposed in this guide is a Catchment Baseline Survey. This provides an overview of the river's geomorphological state and conservation value, identifying problem reaches and the impacts of human-induced change. Classifying reaches into 'problem reaches' and identifying human impacts enables sites which need restoring to be identified and for the programme of restoration to fit in with those human-induced changes. Some human-induced changes may also present longer-term management issues which need to be addressed as part of a broader management plan for the catchment. For example, in urban areas, runoff and sewerage misconnections into watercourses are prevalent environmental problems which cannot be addressed through restoration alone. This ensures that the restoration programme created is sustainable and wholly applicable to the catchment as it identifies the causes of the reach's degradation so that it can be rectified.

Reconnaissance techniques. Stream reconnaissance techniques have been developed and used for the collection and interpretation of both ecological and geomorphological data (see Downs and Thorne, 1996: 455). Reconnaissance can assist in river management decisions (e.g. river restoration and project appraisal) because it allows data to be collected in a standardised and repeatable manner which provides a sound basis for detailed morphological investigation (Thorne, 1998: 29). Thorne's (1998: 44-45) reconnaissance method is a systematic approach for collecting (using a *pro forma* checklist), recording and observing fluvial geomorphological processes. Thorne's technique enables an assessment of the relationships between a channel and its catchment to be made, and the causes of reach instability to be gauged.

Reconnaissance surveys, if undertaken at the pre- and post-project stage, can enable comparisons to be drawn, and for recommended changes to be made in the light of a channel's deviation from its natural form and function. The data obtained from reconnaissance can also be used as a tool for assessing conservation value, process modelling, and for prioritising reaches for restoration. These data can also facilitate an appraisal of ecological and morphological change following enhancement work, as a return survey could be compared against pre-project survey data, with the *pro forma* checklist ensuring that data are collected in an organised and coherent manner (Downs and Thorne, 1996: 463). Despite their benefits reconnaissance surveys are not easily undertaken by non-geomorphologists as the detail required in them may be technically complex to the untrained. Reconnaissance surveys are also relatively long and time consuming, although the detail recorded on them is highly beneficial in facilitating the post-project appraisal of a restoration project.

The River Corridor Survey (RCS) and RHS (although RHS is a form of classification it also provides a checklist which is a form of reconnaissance) are also forms of reconnaissance which provide a standardised means of collecting data. RCS places an emphasis on the reach as the scale for ecological data collection and is a method commonly employed in the UK for assessing habitat quality. RCS provides survey information and fixed-point photographs of specific reaches. Despite RCS's wide usage it has many pitfalls: it does not give consideration to the wider catchment, it only recommends recording habitat features by freehand sketching; and it lacks any spatial referencing (Gurnell *et al.*, 1994: 26). RHS on the other hand is spatially referenced and is collated into a national database. Unlike RCS, RHS surveys geomorphological features (through use of a reconnaissance checklist which surveys the right and left banks of the watercourse). This is important given the close interconnection of geomorphology and ecology.

Thorne's reconnaissance technique and RHS are put forward here as the most detailed form of reconnaissance surveying available for usage on UK rivers. They collate data on a reach's ecology and geomorphology and can be undertaken as part of a desk study to identify the morphological and ecological structure of a reach. The data collected through such surveys can be used at the pre-project stage to identify goals for a restoration project, and they can then be used in a post-project appraisal to appraise a finished project against its previous ecological and geomorphological conditions. Reconnaissance data can also be fed into classifications such as RHS and SERCON and used to classify reaches for conservation.

Table 10 lists the USA's Environmental Monitoring and Assessment Programme and Canada's Visual Assessment of Fish Abundance and Habitat as other forms of reconnaissance surveying which assist in the collection of stream habitat data. Although not strictly related to restoration projects these two approaches provide simple advice on the collection of ecological data on aquatic species. In Table 11 the Geomorphological Survey and Morphological Assessment enable environmental managers to collect data on reconnaissance forms, and from the data collected an overview of a river's current condition and physical character can be provided at the reach and catchment level. This approach can assist in the selection of sites for restoration and preservation depending on the presence or absence of geomorphological features. For example, the lack of geomorphological features such as pool-riffle sequences may signal the need for reach restoration, whereas sites which exhibit natural geomorphological forms and processes simply need to be preserved. These approaches are often undertaken as part of a larger catchment-based programme of appraisal to aid the delineation and selection of sites suitable for restoration.

Reconnaissance is clearly a useful tool for data collection and can assist in the development of priorities for sites based on the presence or absence of ecological and geomorphological features. However, despite the benefits of this technique a range of other approaches have been developed which are more predictive than either classification or reconnaissance.

Predictive appraisal techniques. Predictive ecological and geomorphological appraisal techniques seek to use data to predict the effects of management decisions on a river's ecology and geomorphology. The results of these predictions are then used to make and to justify management decisions for a reach and can be used in the development of priorities for a restoration reach.

Fluvial audits (see Table 11) initially involve the collection of data much like a reconnaissance survey. They focus specifically upon reaches identified in catchment baseline surveys for the undertaking of detailed field studies of sediment sources, sinks, transport processes, floods and land use impacts (Newson and Sear, 2000: 3). These audits identify a range of options for a reach and potential causes of destabilisation. The fluvial audit is more interpretative than forms of reconnaissance as it examines the data collected in order to identify the causes of a reach's instability with regards to the overall state of the catchment. Then the audit proposes alternative management solutions which take account of a catchment's present and future channel instability, helping ensure that suitable and sustainable management decisions are made. This approach is in keeping with the components of appraisal detailed in section 2.1.1 where the importance of siting decision making at the reach level within its wider catchment context was identified. Fluvial audits can also be linked to Geomorphological Dynamics Assessments (see Table 11) which analyse a channel's morphology, comparing its present hydraulic geometry to that of a stable channel and assessing morphological problems. Geomorphological Dynamics Assessments provide managers with quantitative guidance on the effects of intervening (or not) by predicting the impacts upon the reach and downstream river sections. The results of these two forms of appraisal can assist in the development of restoration or rehabilitation proposals in the context of the basin system and local processes, and can also enable the post-project appraisal of completed river restoration projects. These appraisal techniques are, however, costly, time consuming and require in-depth geomorphological training.

HABSCORE (Salmonid habitat assessment system), River Invertebrate Prediction and Conservation System (RIVPACS) and Physical Habitat Simulation Model (PHABSIM) (summarised in Table 10) act as other predictive forms of appraisal. HABSCORE assess the quality of a river's habitat by prediction of Salmonid populations. Empirical modelling is employed in this instance over 30-100m ranges and is based on the presence of habitat features which are favoured by these species for a range of its lifecycles. RIVPACS has similar goals to HABSCORE but focuses on invertebrates, linking water quality and physical structure to the likely location of aquatic invertebrates. PHABSIM assesses the effects of a change in river depth, velocity, cover and substrate on habitat. This has been utilised to model the effects of reach scale restoration or alterations in a reach's management regime upon the physical habitat availability for fish. These three forms of ecological appraisal have been criticised as they do not consider the catchment context. Although alteration of a reach may locally affect ecological populations, their lack of consideration of upstream geomorphological processes is problematic as sediment transport regimes may later destroy the restored reach and thus the benefit of reach-based restoration upon these communities will be negated.

The geomorphological and ecological appraisal tools discussed above and in Tables 10 and 11 can be utilised to assist in the design and implementation of restoration projects and their appraisal. Although many appraisal tools have been developed in the literature and in practice, how and when they are most appropriately employed within an appraisal framework has not been identified. The following section discusses public appraisal tools and after this an appraisal framework is set out. In this framework the tools described in Section 2.2.1 are returned to and their usage at certain stages within a restoration project is identified.

2.2.2 Public appraisal techniques

The EA has made little progress in either developing techniques for involving the public in decision making (Tunstall *et al.*, 2000a: 1) or in undertaking public appraisal in any more depth than basic consultation. As a result, full public appraisal is rarely initiated by statutory governmental organisations. Public perception work has been undertaken in numerous different ways (see Table 12) such as interviews, questionnaires and focus groups, often using photos, drawings or 'preparedness to pay' as a means of eliciting a response.

At present, organisations such as the EA have limited funds and also limited time. This has resulted in consultation or 'awareness raising' being undertaken by means of top-down approaches involving information giving. Tunstall *et al.* (2000a: 8) emphasise the difference between consultation and participation, and Table 12 is subdivided into techniques which are consultative, techniques which are participatory and those which are both consultative and participatory. Consultation is defined here as 'information taking,' for example, leafleting, newsletters, public meetings, exhibitions and questionnaire surveys. It is generally carried out on a one-off basis, usually after decisions have been made. Consultative approaches can be used as part of a larger scheme of public consultation and participation. Consultation, if utilised as the sole means of engaging the public in decision making, can be undemocratic as it is not wholly inclusive and can exclude lay knowledge with an overemphasis on expert-led decision making. However, consultation techniques can be employed in tandem with 'planning for real' or open days to elicit a more inclusive appraisal of public opinion. Although consultative procedures are useful they do not give the public the chance to directly inform the decision-making process because ultimately the final decisions are made by the decision maker(s) and not the public.

Participation, on the other hand, aims to be more inclusive and is a form of 'information giving' involving the local community from a project's start until its completion (Tunstall *et al.*,

Table 12. Public appraisal techniques

Title of appraisal technique	Description	Where used	Reference
a) Consultation			
Exhibitions	Informative, make public aware of plans to give opportunity to inform decision-making	UK, River Brent (North London)	Tunstall *et al.*, 2000a
Leaflets	Informative, make public aware of plans to give opportunity to inform decision-making	UK, River Brent (North London)	Tunstall *et al.*, 2000a
Questionnaires	Ascertain public perception of river restoration works	UK: River Cole (Swindon); River Medway (Kent); River Ravensbourne (South London); River Skerne (Co.Durham); two Hampshire Rivers and Upper River Kennet (Wiltshire)	Eden *et al.*, 2000; Fordham *et al.*, 1991; Gregory and Davis, 1993; House and Sangster, 1991; Sawyer and Fordham, 1994; Tapsell *et al.*, 1992; Tapsell, 1995; Tunstall *et al.*, 1999; and Tunstall *et al.*, 2000a
Public meetings	To gain public approval and/or feedback on decision-made	UK: River Ravensbourne (South London); River Brent (North London)	Tapsell *et al.*, 1992; and Tunstall *et al.*, 2000a
Public enquiries	Usually driven by public outcry	UK: Upper River Kennet (Wiltshire)	Sawyer and Fordham, 1994
b) Participation			
WaterWatch	Waterway monitoring, environmental education and awareness programs for local communities	Australia	Chalkley *et al.*, 1999
Open days/walks	Informative, make public aware of plans to give opportunity to inform decision-making	UK, River Brent (North London)	Tunstall *et al.*, 2000a
Planning for real day	Bottom-up decision-making	UK, River Brent (North London)	Tunstall *et al.*, 2000a
Involvement of school Children	Include children in decision-making process as they are prime users of	UK: River Brent (North London) and River Ravensbourne (South London)	Tapsell, 1997; and Tunstall *et al.*, 2000a

	outdoors		
Citizens advisory Groups or committees	Small group of citizens provides advice on public issues	USA	
Visioning	Local people delineating how they would like to see their neighbourhood in 20 years time	Uncertain	
Citizens juries and Panels	To make a decision through expert and witness panels	USA, Scotland	Coote, 1996; Newman *et al.*, 1998; Prior *et al.*, 1995; and Stewart *et al.*, 1994
c) Consultation and participation			
Round tables	Public consultation	Canada	Isaacs, 1993
Focus groups	Ascertain public perception of river restoration works	UK: River Cole (Swindon); River Brent (North London)	Eden *et al.*, 2000; Tunstall *et al.*, 2000a; and Tunstall *et al.*, 2000b
Interviews	Ascertain public perception of river restoration works	UK: River Cole (Swindon); River Medway (Kent); River Ravensbourne (South London); River Skerne (Co.Durham) and Upper River Kennet (Wiltshire)	Eden *et al.*, 2000; Fordham *et al.*, 1991; House and Sangster, 1991; Sawyer and Fordham, 1994; Tapsell *et al.*, 1992; Tapsell, 1995; Tunstall *et al.*, 1999; and Tunstall *et al.*, 2000a

2000a: 8). In Table 12 the more participatory approaches can be seen to involve the public directly in the creation of a vision for their watercourse. More bottom-up participatory approaches such as 'planning for real' (Tunstall *et al.*, 2000a), citizens' juries, panels, round tables, workshops, citizens' advisory groups, committees and 'visioning' can be employed whereby lay opinion can directly influence decision making. By using participatory methods public concerns and requirements can be fed directly in to the decision-making process and the project's design. These techniques are not implemented very often and hence their adoption is presently slow. This is likely to be related to the fact that they are both expensive and time consuming. Also, although these techniques are empowering to the public who give invaluable information to the experts, they can be disempowering to environmental managers who essentially hand over many of their decision-making powers to stakeholder groups.

Many of the techniques depicted in Table 12 are both participatory and consultative (e.g. round tables, focus groups and interviews). To successfully appraise lay knowledge a combination of the approaches touched upon above should be utilised. However, the techniques selected to appraise public perceptions will need to differ from one community to the next. An approach used on one river and community may not necessarily be appropriate in another situation due to the non-homogenous nature of the public and the different characteristics of the watercourse.

When undertaking public perception work it is important to consider the issue of timing. If it is undertaken at too late a stage then it risks being classed as mere tokenism. However, if undertaken too early it risks getting people's hopes up and raises false expectations should the project not go ahead, or if, for practical reasons, the project's scope is subsequently limited. Great consideration needs to be given to the stage at which the public should become engaged in decision making so as to ensure inclusiveness and democracy (this will be discussed in greater detail in Chapters 5-7).

Public perception studies should be undertaken in a democratic manner in order to appraise the opinions of the local community as widely as possible without prejudice to certain opinions over others. The sampling frame for the public appraisal must therefore be sufficient to achieve this. The appraisal techniques adopted should reflect the nature of the community. For example, on the River Brent 'Planning for real' and 'Visioning' were successful in gauging public opinion, and a combination of consultative and participatory techniques is recommended to incorporate public vision whilst also enabling environmental managers to put across their visions for the environment as well. Public involvement needs to be undertaken at all stages of project planning and implementation to ensure a project's long-term adoption by the local community. Thorough and democratic public consultation is vital for a project's long-term adoption, as public contentment will engender a sense of ownership and reduce the likelihood of a site deteriorating. Public participation also enables the incorporation of local knowledge into the decision-making process. This is important during project design as people's intimate day-to-day knowledge of both the catchment and the river can add to that of the experts. The extent of public participation in a project varies between projects, as do the techniques utilised to appraise public opinion.

2.2.3 Summary

This section has discussed and evaluated a range of ecological, geomorphological and public appraisal techniques. No one technique was posited over any other, since the selection of appraisal techniques will be specific to the context of each individual restoration project, based upon factors such as the aims and objective of the project and on the funds available for the project. This section has discussed the pros and cons of a range of appraisal techniques in order to provide a background to the subsequent chapters of this thesis when a range of projects are discussed. This discussion of techniques has also provided material for the following section where an appraisal framework is put forward. It will be shown that these techniques act as tools in the undertaking of a project appraisal from the start to finish of a project.

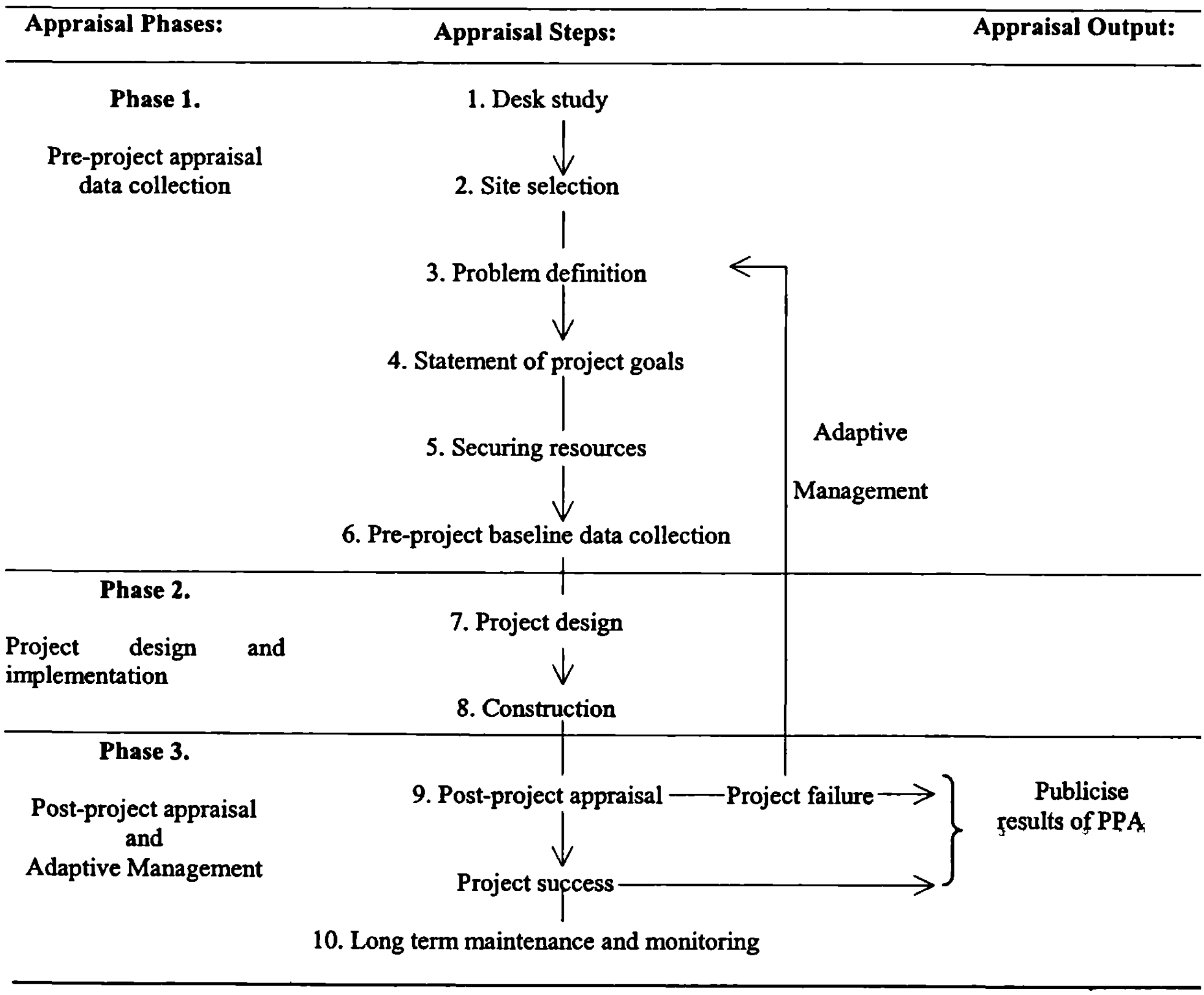
2.3 Appraisal: a framework for river restoration

It has been demonstrated in Sections 2.1 and 2.2 that although many appraisal frameworks and techniques have been discussed in the literature, the structure of the river restoration appraisal process as a whole has not been given sufficient consideration. In general, discussions of appraisal frameworks have relied too heavily on EIA as a model and have not been sufficiently tailored to the specific needs of river restoration. In Section 2.1 three components of river restoration appraisal were highlighted. It was argued that project appraisal needs to be initially undertaken at the catchment scale, and that it should include geomorphology and public participation as components of a larger appraisal framework. The following section puts forward an appraisal framework which incorporates these three components using the techniques discussed in Section 2.2. This framework is then used throughout the remainder of the thesis as tool against which to evaluate project appraisals undertaken in the UK at the national and regional scale. This framework is revisited in the concluding chapter where amendments are proposed in the light of the research findings.

The design of the framework is underpinned by the recognition that, through the delineation of clearly-defined aims and the collection of comprehensive pre-project baseline data, appraisal enables project success or failure to be evaluated and the final design to be returned to and amended if failure occurs. Appraisal is thus the true 'acid test of restoration' (Bruce-Burgess, 2001b: 81) as it enables practitioners to learn from past mistakes and thus facilitates advancements in the understanding and practice of restoration.

The resulting framework is divided into three phases and ten steps (see Figure 6). The purpose of these steps is to act as a checklist to ensure that adequate data are collected, facilitating a holistically-designed project and enabling post-project appraisal to be undertaken. The division into ten steps is solely to aid description here as it is acknowledged that in reality a project may not necessarily follow the precise order prescribed. The ten steps act as a template to ensure that all necessary data are collected at all stages of the project. In this thesis monitoring and post-project appraisal are seen as components of a wider project appraisal, whereas previously they have been seen as stand-alone activities. It is also argued here that appraisal should occur across a range of spatial scales starting at the catchment level and moving down to the sub-catchment, river, reach and sub-reach levels. This framework is developed specifically for the UK context. As was discussed in section 2.1, appraisal frameworks are not easily transferred between different countries as they are tailored to specific regulatory frameworks.

Figure 6. Ten-stage river restoration project appraisal procedure



2.3.1 Phase 1. Pre-project appraisal: data collection phase

(i) Steps 1-2. Desk study and site selection

The desk study and site selection processes are identified as separate in Figure 6 yet are discussed together here as they influence each other and in some cases overlap.

Desk study: catchment characterisation. The first step in the project appraisal process involves a catchment-scale desk study. This is very important as it aids the site selection process, and, according to FISRWG (1998, Chapter 4: 16), acts a means of identifying problems and opportunities. Through data collection and analysis a desk study establishes existing stream corridor structure and function and the nature of disturbances. It also helps to identify the problems and opportunities for stream restoration. Desk studies can be undertaken at the catchment and reach scale. The catchment-scale desk study forms part of the site selection process (Step 2) through providing an understanding of the processes operating at the catchment scale, while the reach-based desk study is undertaken in Step 6 to supply baseline data at a reach level.

The reconnaissance techniques discussed in section 2.3 can be used as a means of collating data for this desk study. For example, Thorne's reconnaissance sheets would enable data to be collected in a standard format so that it could be returned to later and used in a post-project appraisal. Appraisal techniques such as the catchment baseline survey could be employed to gain an overview of the catchment's geomorphological behaviour identifying zones for preservation or restoration. This survey could be used to select reaches for restoration and help delineate geomorphological targets to improve degraded reaches so as to benefit the geomorphology of the catchment as a whole.

In addition, the desk study should examine all appropriate existing catchment level data, such as: Catchment Abstraction Management Strategies; Catchment Management Plans and Catchment Flood Management Plans; geomorphological catchment baseline surveys and fluvial audits; historical data (e.g. flood maps, photographs, newspaper cuttings, personal accounts); past channel management records; RHS; River Landscape Assessment (NRA, 1992a; and Copas, 1997); and Unitary Development Plans. A Geographic Information System (GIS) or Decision Support System would enable these data to be overlain in map form and all physical and social data reviewed together, allowing sites to be selected based on:

- Existing nature conservation designations (e.g. Areas Of Outstanding Natural Beauty (AONB), SSSIs);
- Water Framework Directive designations (e.g. sites of good ecological status and HMWBs);
- Flood risk (Section 104 modelling and Indicative Floodplain maps);
- Geomorphological adjustment (e.g. zones of erosion and deposition);
- Land-use, such as:
  - Farm land;

- Industrial land (e.g. chemical/nuclear plants, industrial estates, mining);
- Green belt sites;
- Brownfield sites;
- Parkland (e.g. country parks and urban parks);
- Privately-owned land/estates (e.g. Crown Estate, National Parks, EA owned reaches, National Trust or Ministry of Defence land);
- Urban areas (e.g. housing developments, towns, and shopping centres); and

- Pollution/land contamination (e.g. industry, sewerage treatment works and waste).

This desk study also enables environmental managers to identify community groups within the catchment who will be consulted throughout the restoration project to influence the site selection and the project's design as local conservation bodies may be able help to identify appropriate sites for restoration that might otherwise have been overlooked. The environmental manager may initially be unaware of 'WaterWatch' groups or divides within local communities which could hinder or enhance the development of a restoration project. Local press releases or river open days could provide a forum for environmental managers to discuss the potential opportunities of restoration projects with local communities. In seeking to establish partnerships it will be important for the environmental manager to discuss potential opportunities with local authorities whose input will be pivotal in securing links between the body undertaking the restoration project and the local community. 'Visioning' techniques and 'Round Table' discussion groups could be used throughout sub-catchment areas to develop a list of potential restoration sites. The results of these forums could then be coupled with catchment-scale physical data in the selection of sites and options which benefit nature and the community.

Although considering the whole catchment at the outset is initially time-consuming it does shorten the other steps in the appraisal process as these data can be reused from Step 3 onwards. This approach allows sites to be selected to complement past management practices both upstream and downstream. For example, if a restoration site was selected upstream of a WFD nominated 'site of good ecological status' then restoration options would have to complement this site's management and not negatively impact its status. According to Everard and Powell (2002: 331), systems-based planning of the water environment which relates local decisions to catchment-scale process is paramount in progressing towards sustainability. During site selection, streams and reaches which can recover independently of human intervention or with minimal intervention can also be identified, helping save money and enabling the identification of activities in the catchment which could compromise natural recovery (Bartley, 2000: 11; see also Graf, 1996: 469).

Site selection. Selecting sites and reaches for restoration is the starting point of all restoration projects and is arguably one of the most important stages as the location of the project should benefit the environment and the local community. Selecting a site which can provide the greatest environmental and social benefit at the reach and catchment level is important. Careful site selection enables all likely project constraints to be identified at an early stage, hence preventing delays later on. At this stage, problems within the catchment can also be identified through desk-based studies e.g. catchment baseline surveys, fluvial audits and EA Indicative Floodplain maps. Through the identification of problems, remedial options and sites for restoration can be identified as solutions. In some instances these solutions may not necessitate river restoration but instead require increased river corridor management. This phase of appraisal also enables potential conflicts of interest to be identified and mitigated against at an early stage.

The importance of selecting the best site for a project makes it a complicated matter to undertake, and environmental managers often face the question of whether to restore the most pristine or the most degraded sites. On the one hand it can be argued that the most damaged sites warrant our attention because they need to be returned to a more sustainable path. On the other hand, it can also be argued that near-natural sites should be preserved in order to maintain their present status (as suggested by Graf, 1996; and Frissel *et al.*, 1986). Presently in the UK, projects are not necessarily selected systematically nor do they form part of a list of priority restoration sites. More often than not sites are selected as and when opportunities arise – generally linked to and funded by flood defence projects or major development projects (e.g. housing, retail and infrastructure).

If site selection is nested within a catchment framework, sites could be selected to benefit both upstream and downstream reaches so that the advantages of a restoration would not be limited to one specific site but would ameliorate other reaches too. The recent WFD may have the potential to aid this site selection dilemma, as it identifies HMWBs and sites of good ecological status at priority locations. These classifications may aid river managers in the identification of sites for restoration and preservation, also identifying sites which may be too damaged for it to be cost-effective to rectify. The desk study provides managers with an overall understanding of the catchment's characteristics, of potential sites for restoration, and of the causes of problems for and constraints to restoration. The knowledge gained from this desk study is then used to inform the site selection process. As stated earlier, the desk study will involve the consultation of stakeholders to aid this site selection process. Once a site has been selected the stakeholders for the site in question should be identified as the appraisal of their perceptions throughout the remainder of the project will be paramount.

(ii) Step 3. Problem identification and definition

If the approaches detailed in Steps 1 and 2 are undertaken, then the following step is relatively easily and quickly achieved. Step 3 involves a clear definition of the problem or problems to be tackled during restoration, requiring that all symptoms and causes of the problems be identified and described. Problem identification is very important for the following reasons:

- It can enable the development of a clear restoration plan which tackles both the symptoms and fundamental causes of the problems effectively; also
- It benefits Step 9 of the appraisal process (post-project appraisal), enabling the restored reach to be appraised against the pre-restoration state, assessing whether the initial problems identified have been rectified.

It is likely that there will be numerous symptoms and causes of problems which will all need addressing if the restoration process is to be successful. Thus, problem identification and definition needs to be undertaken at the catchment and reach scales, because a reach-scale problem may have a catchment-scale cause. For example, on the River Skerne project poor water quality was identified as a problem caused by urban runoff from the catchment and foul water misconnections to the river (RRC, 1998). Although these problems were identified the development of solutions to rectify this problem were not sought as it would require a catchment-level solution when funds only existed for a reach-level solution. Thus the misconnections on the restoration reach were restored, yet the catchment-wide runoff problem was not solved, hence the water quality was not totally ameliorated following restoration. Clear articulation of problems, their causes and their symptoms may help in the recognition and diagnosis of the cause of a problem and thus may assist the development of appropriate restoration designs in Step 7.

(iii) Step 4. Statement of project goals

Once the problems have been clearly defined then potential solutions can be developed. The development of restoration goals and visions is one of the most important phase of pre-project appraisal as it ensures that goals are developed to help achieve a project which has the potential to be both environmentally and socially sustainable. In Germany the *Ökologische Leitbild* concept has been used to help develop restoration project goals and visions. This translates as an 'ecological guiding view' (Muhar *et al.*, 1995: 188). This concept takes a river's pre-disturbance condition as a template, providing an ideal vision for the site if constraints were not a limiting factor. Another possibility is the selection of a pristine reference reach to act as a template or 'end-point', although this, is not an easy task (see Landers (1997) and SER (2002) for definitions of 'end-points'). In this thesis the terms 'end-point', 'template' and 'benchmark' are used interchangeably since it is not clear what exactly the term 'pre-disturbance' means, and also whether a particular reference reach is an appropriate end-point for the river or catchment in question (see Muhar *et al.*, 1995).

It is also necessary to consider all reach and catchment-scale constraints identified in the previous steps when defining the project's aims and objectives. Public consultation will also identify what the local community wishes to be considered as the vision for the site. The geomorphological appraisal techniques identified in section 2.2 (e.g. catchment baseline survey, fluvial audit) can also be employed as tools at this stage to help identify goals which will be suitable for the reach in question and which fit in with the geomorphological processes operating within the catchment as a whole.

Goal articulation and development forms an important component of the *Leitbild*, and is used to guide the vision during restoration planning. According to SER (2002: 7), if goals are seen as ideals, then objectives are concrete measures that can help attain these goals. In developing goals it is important that they are realistic for the catchment in question. A clear statement of goals is also important for later post-project appraisals because 'it is only when the goal is clearly articulated that an outcome can be evaluated to determine whether or not the management was successful' (Keddy, 1999: 717). Hence, clear goal development reduces chances of failure as it makes the restorer think clearly and realistically about what he or she hopes to achieve given clear problem articulation. Carefully selected goals can be used to help define:

- The potential end point of the channel after restoration (assisting in the delineation of reference sites/conditions);
- The different phases of the project from the pre-project baseline data collection stage, through to design and post-project appraisal;
- The types of restoration measures that need to be implemented;
- The data/information to be collected in the pre- (baseline data collection, Step 6) and post–project appraisal (Step 9);
- The appraisal techniques to be used; and
- The criteria against which project success will be evaluated.

Goals should be set first at the catchment scale, then at the reach scale. Constraints to undertaking these goals need also to be understood at both scales (Ladson *et al.*, 1999b: 381). For example, a catchment-level goal may be to restore the connectivity between rivers and their floodplains, whereas a reach-level goal may be to remove a concrete channel and restore its geomorphological character with a view to linking the river to its floodplain.

In addition to spatial scale, the temporal scale of the goals needs to be established, delineating short-, medium- and long-term goals. Short-term goals may be needed to satisfy funders and local communities. For example, a short-term goal might be to appraise whether a restored river reach is utilised for recreation to a greater extent than previously. These goals will be appraised and reported shortly after the project's completion. In contrast, long-term goals will project into the future, forming part of a long-running post-project monitoring scheme. Geomorphological goals are likely to be long-term as restoration of catchment and reach geomorphology and sedimentology may take decades.

According to Rutherfurd *et al.* (1999: 72) goals should be 'expressed in such a way that you will know they have been achieved.' Hence they need to be a 'clear, precise, and measurable statement of what you aim to achieve' (Rutherfurd *et al.*, 1999: 134). Clearly defined, quantifiable goals will help formulate the design processes and decide the restoration techniques needed. They will also enable comparisons to be drawn between pre- and post-project conditions, allowing project success or failure to be ascertained (Cairns *et al.*, 1993: 2; and Downs and Kondolf, 2002: 479). Ladson *et al.* (1999b: 381) also suggest that clear statement of goals is imperative for project success, because 'if we know what it is we are trying to achieve then it is (comparatively) straightforward to get there.' Goals should not only be physical environmental goals, but should also include political, economic, social and cultural goals. These will, of course, depend on the specific catchment and reach (FISRWG, 1998: Chapter 5: 1). At this stage suitable success indicators need to be selected to enable achievement of goals to be appraised in Step 9.

Clear goal articulation is an important stage of the appraisal process as it enables one to make a rational judgement about a scheme's performance at a later stage. Goal articulation also feeds into the design stage as it delineates the parameters and features to be restored, and helps to define the temporal and spatial scale of a project. Goal articulation should be undertaken by decision makers with the input and consensus of an advisory group derived from interdisciplinary technical team(s) and stakeholder groups (FISRWG, 1998: Chapter 4: 10-13). Stakeholders' input should have commenced at the outset of the appraisal process during the desk study at the catchment scale, then once a site has been selected for the project the stakeholders for the specific site will be identified through open consultation (e.g. door-to-door questionnaire surveys and interviews as employed on the Skerne restoration project) and participatory appraisals (e.g. planning for real) which will discuss goals for the project with all those who stand to be affected and wish to influence the project's design. This stage of public appraisal and stakeholder involvement may be time consuming as the goals for the site should be developed to incorporate their ideas whilst also balancing the environmental and practical requirements of the project. Once an idealised vision is created through *Leitbild* and goal development, a process of rigorous pre-project appraisal should ensue, enabling a river's problems and constraints to be clearly identified and defined, and priorities for action developed.

(iv) Step 5. Securing resources

This step does not need to occur after the project's goals have been developed as this may slow down the process of getting a project started. However, it makes sense for resources to be secured after goals have been developed, as the more extensive the goals then the greater the quantity of financial and human resources that will be needed to achieve them. The temporal and spatial scale of the goals and the level of technical expertise required will help define the resources needed for the project's execution.

Human resources will need to be developed for the project's execution through the creation of a multidisciplinary project team, including input from stakeholder groups. Time plans, financial plans and decision-making structures should be developed in tandem with the project's design (Step 7) to ensure that the project is executed within given temporal and financial constraints, and as part of a democratic decision-making structure which includes representatives from all stakeholders (including the public). At this stage it is necessary to draw up a list of the project's design team and the likely project partners. The design team selected will reflect the goals delineated in Step 4. It will need to include individuals with the relevant experience in important elements of the project (e.g. ecology, hydrology, geomorphology, public liaison) and a background in river restoration. It will need to take into account whether the individuals have worked together previously.

Financial resources will have to be allocated for all stages of the project – pre-project appraisal and reconnaissance, public appraisal, project visioning and design, construction through to post-project stage – and also reserve a contingency fund to buffer against the unexpected. The manner in which finances are allocated throughout a project is a central reason why project appraisal has been limited on many projects as funds are generally made available for undertaking the project with no money left in reserve for post-project appraisals. Budgeting is important from an early stage, as available money will very much define the scope of the project. In an ideal situation one would have a set pot of money which can be spent as and when the stages of the project are undertaken. However, in reality, funds often have temporal constraints attached to them, meaning that if they are not spent within an allocated time frame they can risk being revoked thus preventing the project from going ahead. In allocating funds one needs to plan for all stages of the project and develop a realistic programme of works which will ensure that the various stages of the project are undertaken within these tight time frames. Uncertainty also needs to be built into these time frames. For example, if delays are incurred in the project's completion then additional sources of funding must be sought as a contingency measure. Or maybe the project can be undertaken in small phases whereby additional phases are built on to the first phase as and when new funds become available. Aside from time constraints the source of the funding may have requirements which may influence the project's design. These requirements need to be considered early on in a project and incorporated in order to secure the funding.

A time plan will need to be developed for the project's execution (including immediate post-project appraisal and long-term monitoring and maintenance). Time scales must also be compatible with the time scales over which ecological and geomorphological processes operate. For example, ecologically speaking, restoration work should not be undertaken during sensitive periods (e.g. fish spawning periods, seedling establishment, and bird nesting periods). It would also not be advisable to carry out restoration work during winter periods when the flow of the river may be higher. Restoration work will often leave bare surfaces (e.g. banks) which are particularly prone to erosion during higher winter flows. This was a problem on the River Cole where the clayey-nature of the banks meant that revegetation was slow. Planting of banks with rapid colonisers may be advised to reduce the risk of erosion. It may also be necessary in aesthetic terms to counter the public's negative opinions with regards to unvegetated river banks (as happened on the River Cole). Time plans will also, however, be dictated by the temporal constraints placed on budgets (requiring money to be spent within a financial year) which requires results to be fed-back to funding bodies at an early stage.

(v) Step 6. Pre-project baseline data collection

Baseline data collection is important because it provides a good record of the site's pre-project physical and ecological character. It also helps develop a project's design and provides the basis for post-project appraisal. Data should be collected across nested spatial scales, from the catchment, river and reach to the sub-reach (e.g. riffles and pools). The type of baseline data needed to inform a project's design and post-project appraisal will be determined by the project's goals (delineated in Step 4). For example, if a project's goal was to restore a reach to its 'pre-disturbance' character then baseline data may be collected from a reference reach (or historical maps of the reach) to act as a design template. At this stage it is important to think about the exact forms of appraisal that will be undertaken at the post-project stage in order to ensure that sufficient quantitative data are collected to enable post-project appraisal to be undertaken. The precise location of channel cross-sections or the extent of sampling frames need to be determined.

Reference reaches and impact reaches. During this stage of project appraisal reference reaches and impact reaches may be defined. Reference reaches are important as they enable targets or performance indicators to be extracted for use in post-project appraisal (NRC, 1992: Chapter 3). For example, a reference reach may be utilised as a geomorphological guide for the restored reach, helping to define the desired shape of the channel and the nature of the sediment sources. The ecological communities exhibited at the reference reach may be used as a performance indicator for the restored reach. Hence if the recreation of the Salmonid habitats exhibited in the reference reach is a goal of the restoration project, then the restoration site's achievement of this would be used as a gauge of its success. Impact reaches are also important because they enable a project's downstream effects to be appraised. Thus, although a restoration project may locally seem to be a success the alteration of the reach's geomorphology may in fact be having a negative impact on the downstream reaches by causing excessive sediment accumulation and blockages.

Desk study: reach characterisation. Baseline data collection is effectively commenced in Step 1 during the desk study. All material collected during this phase can now be returned to and used again, although additional reach-level data will be required (e.g. reach-level historical maps; photos; geomorphological; and past management activities). Additional data necessary for the project's design may include reference state information, inventories of existing features such as the key BAP species and the input of the local public. BAP species will need to be preserved, thus baseline information must be collected on the physical conditions of their habitat in order to ensure it is either preserved or can be reconstructed. The baseline data collected to enable post-project appraisal should include the performance indicators for the project's goals. Public appraisal at this stage is also important, gauging public pre-project opinion that can be returned to at the post-project stage in order to evaluate whether the local community prefer the restored site or the original site (this approach was utilised successfully on the River Skerne project). The public's visions for the site should also be appraised, in order to engage them democratically in the decision-making process, ensuring that the vision created for the site is not only environmentally, but also socially acceptable.

Reconnaissance field survey. Aside from a reach-based desk study, data also need to be collected in the field to ensure that adequate data are collected for the project's design and post-project appraisal. Reconnaissance surveys such as RHS (Raven *et al.,* 1997; Raven *et al.,* 1998: and Raven *et al.,* 2000) or Thorne's (1998) reconnaissance survey are recommended as they enable a scheme to be placed within its environmental context (Downs and Skinner, 2000: 11). Reconnaissance also provides an inventory of site characteristics, and is beneficial because it is easily replicable using standard inventory sheets, making it a suitable medium for making pre- and post-project comparisons of performance indicators to measure goal attainment. During reconnaissance surveys, fixed-point photography should also be undertaken and a video recording of the site at the pre-project stage could be useful at later stages for demonstrating the benefits of the project to wider groups. Baseline data should be geo-referenced using a GPS for spatial accuracy, also enabling post-project monitoring data to be collected from the same locations and mapped in a GIS format.

There is still little consensus on the time period over which baseline data need to be collected to be sufficient. However, it is agreed that it should be extensive enough to account for seasonal variations and it should also be sufficient enough to describe the range of natural conditions (O'Keefe and Uys, 2000: 448) and the scales and rates of river processes. A reconnaissance survey is recommended, backed-up by historic records such as maps, photos and flow data. Baseline data collection is also important because should the project fail it may be necessary to return it to how it once looked, or to find out what went wrong and make appropriate changes to rectify the situation.

2.3.2 Phase 2. Project design and implementation

(i) Step 7. Project design

This step is informed by the goals developed in Step 4 and the baseline data collected in Step 6. It is divided into five stages:

- Development of design options;
- Feasibility study of options available;
- Option selection;
- Design drawings and engineering brief; and
- Selection of contractors.

During this step reference data are used to help develop restoration options for the site, with design input from the multidisciplinary team selected in Step 5. During the creation of design options the restoration techniques which will be employed are delineated. This phase culminates in a range of design options from 'do nothing' through to full restoration (with natural recovery as an interim option especially on high energy streams) leading to a final option selection.

A feasibility study for the most suitable option is then undertaken to ensure that the design will not have adverse impacts locally or at the catchment scale, ensuring that it achieves the project's short-, medium- and long-term goals. At this stage a construction impact assessment may also be undertaken to identify potential short-term impacts and find ways to minimise these impacts (e.g. sediment traps). Feasibility also includes an analysis of cost-effectiveness to see if the scheme can be undertaken within its budget. If the design is too costly then it will have to be reappraised and the most important elements prioritised. Ancillary components should be set aside for execution at a later date. If this does occur then the reappraisal should ensure that changes to the designs do not have a negative environmental impact and are in keeping with the project's goals. The feasibility stage also involves a risk analysis of environmental components, project finances and health and safety issues.

Once the project's feasibility has been assured it is then worked up into design drawings and an engineering brief for use by the contractors in its construction. Downs and Kondolf (2002: 479-480) emphasise the need for an explicit design rationale and design drawings which will help to gauge future channel alterations and will act as a baseline to compare the as-built channel against original designs. At this stage the temporal and financial plans delineated in Step 5 are returned to and funding is more specifically allocated towards the construction and labour costs, with a contingency fund being set aside (the size of this budget will be dependent upon the size of the project and whether budgetary resources are sufficient to enable this). Construction and post-project appraisal time frames are specified. A midcourse correction point for adaptive management should be established in the time plan that will enable a reappraisal of the project in case it is not going as planned, or in case unexpected constraints (such as flooding) cause a delay to the schedule.

Finally, the selection of appropriate contractors and engineers who have experience in undertaking restoration work is very important at this stage, as a team experienced in natural channel design could significantly affect the success rate. The RRC may be able to provide advice on selecting contractors.

(ii) Step 8. Construction

At this stage it is important that the project's design specifications are comprehended and adhered to by the contractors. Many contractors who have been used to digging straight channels in the past are now required to excavate meanders. This change in ethos to restoring channels can be a leap of faith for many contractors. In order to ensure that designs are adhered to, continuous and on-going site supervision is seen as imperative to project success. A member of the restoration team who fully understands the technical specifications should be onsite during the early phases of construction. Much benefit can be gained from explaining the project details to the contractors who may have no past experience of natural channel construction. The contractors need to be fully briefed as to what is to be achieved by the project, and the use of landscape architects' design plans and cross-section diagrams can help to visualise the requirements of the project. Without site supervision there is a risk that the channel's dimensions will be cut symmetrically, or other design features for the project will be lost, with potentially negative consequences for the site's long-term future and geomorphic stability. It is also important to draw-up contracts between the restoration team and the contractors to prevent problems occurring that may negatively affect the designs and the detailed time plan.

2.3.3 Phase 3. Post-project appraisal and adaptive management

Once a project has been constructed it is often assumed that this is the end of the process. However, in reality, this is but the beginning of the site's long-term future management and is hence arguably one of the most important phases of the project. At this stage the appraisal framework subdivides into two sections: post-project appraisal, which is the long-term appraisal of the project's achievement of its initial goals; and the process of adaptive management. Adaptive management is no longer part of project appraisal but is the manner in which the project is managed in the future to adapt to future changes across the catchment and to alter elements of the restoration project to deal with components of the project which do not achieve their goals. Nested within adaptive management is the long-term monitoring and maintenance of the site.

(i) Step 9. Post-project appraisal and adaptive management

Post-project appraisal falls into two categories: as-built post-project appraisal – which is an immediate post-construction appraisal of a project's adherence to design documents; and long-term post-project appraisal during which a scheme's achievement of its goals is appraised. This occurs immediately post-construction and then at regular intervals throughout subsequent years and involves the collection and the analysis of long-term monitoring data (Step 10). Post-project appraisal should be undertaken in the short- and long-term and at the catchment and reach scales, using the project's goal indicators to gauge success.

Post-construction appraisal (referred to as a 'compliance audit' by Downs and Skinner, 2000: 11) evaluates the scheme against the achievement of its original design specification (e.g. channel location, geomorphological structure, ecological composition, aesthetic and amenity requirements). This is important because a scheme could be defined as a failure when in actual fact it had been constructed incorrectly by the contractors. If this is the case then the contractors can be brought back to rectify incorrect elements. At this stage it is important to be aware of the short-term impacts of the scheme's construction (Brookes *et al.,* 1998: 25). For example, construction could cause siltation and obscure riffles, making a scheme look as if it has failed when in fact it is stabilising itself. It is important at this stage to both expect and create the opportunity for ecological and geomorphological self-adjustment, and to anticipate whether this self-adjustment will be environmentally- and socially-sustainable.

Short-, medium-, and long-term post-project appraisal. The next stage of the post-project appraisal evaluates the project against its achievement of, first, its short-term goals and, later, its long-term goals for the catchment and the reach. This short-term appraisal is referred to as a 'performance audit' by Downs and Skinner (2002: 11) and compares the actual environmental impacts against the expected impacts. This should initially be undertaken regularly to account for seasonalities (on a four monthly basis), and then once the scheme has stabilised be undertaken on an annual/bi-annual basis. Long-term post-project appraisal compares actual environmental impacts against expected impacts and project goals using long-term monitoring data.

In the long-term, partnership between environmental managers and universities, schools and neighbourhood groups should be fostered. The development of such partnerships leads to the creation of a volunteer labour force who can be trained to collect monitoring data in the long-term. These data can be then fed back to the environmental managers to appraise the project through an extended period of time which would otherwise be hard to achieve. Having a wide range of inter-disciplinary groups undertaking such work also ensures that any problems in the restoration reach are identified at an early stage. This has mutual benefits to the environmental managers and the organisations undertaking the monitoring as the data can be used as part of an individual's independent research yet feeds results back to the body who undertook the project in the first instance.

Whether a project is a success or not, the publication of its results should be encouraged. Success should be seen as the achievement of both short- and long-term goals, and the initial findings should be publicised in the interim. Publicising results can 'improve restoration procedures by accelerating the evolution of management principles and techniques (adaptive management)' (Keddy, 1999: 716). If the project succeeds then post-project appraisal and Step 10 are proceeded with. However, if it fails then a phase of adaptive management is embarked upon. This phase involves returning to earlier steps in the appraisal process. If the cause of failure is not obvious then it is worth reinvestigating the choice of goals and re-examining the choice of design to see why failure occurred. If the cause of the failure is found and the scheme is not an outright failure then only the failed elements should be rectified whilst giving due consideration to the effects of this change on the scheme as a whole. If the project is an outright failure then it may be worth reconstructing it or returning it to its prior state so that it does not negatively impact on the rest of the river. In some cases the project may fail to achieve its goals but the end product may far exceed the expectations of the original vision. For example, failure may be related to the timescales utilised for appraisal, as insufficient time may have been given for the river to self-adjust than is required and therefore the project may initially appear to have failed to reach the original aims and objective identified. In such instances it may not be desirable to reconstruct the project, but instead establish the reasons why failure occurred, and then undertake a reconnaissance survey of the new site conditions for future post-project appraisals. If failure is not due to the design but instead due to poor contractual implementation then contractors should rectify their mistakes to fulfil the design criteria. In addition, a project may initially appear to be successful but may encounter problems in the long-term associated with changes at the catchment level. A process of adaptive management should undertake changes to the project to mitigate these effects if they were deemed to be negative or detrimental to the project.

(ii) Step 10. Long-term maintenance and monitoring

This final step includes a long-term commitment to post-project appraisal (dependent on budget), the collection of monitoring data (as part of a long-term site management plan) at regular intervals using repeatable survey techniques and reconnaissance surveys, and also a commitment to site maintenance. This phase should be fully factored into the costings made in Step 5. However, costs could be reduced by engaging local communities, schools or universities in regular monitoring activities. During this phase long-term post-project appraisal data can be analysed and lessons learnt about the restoration process. According to Rutherfurd (2000: 10), streams are likely to recover at a much slower rate than they were damaged, thus it may take decades to witness changes in biological communities and geomorphological processes. This point is reiterated by Brookes *et al.* (1998: 25) who emphasise that it may take five, ten or fifty years for a project to be fully operational, thus short-term conclusions should be treated with caution. The recovery rates of stream will vary according to factors such as stream power, ecological colonisation and also the manner in which human populations adopt their restored river.

This final phase will thus be much longer than the previous nine steps, which can be rapidly implemented. It is thus important that the restoration team are committed to the site's long-term maintenance, and that routine maintenance works undertaken on the site do not inadvertently harm the project. Maintenance work should form part of the site's long-term management plan, and should be sensitive to breeding and spawning seasons and always undertaken under the supervision of a member of the project's river restoration team. Post-project appraisal results should be disseminated widely to all those involved in the field of restoration including stakeholder groups so that the benefits or failings of certain techniques or approaches can be widely appreciated.

2.3.4 Summary

This section has brought together the appraisal techniques and components of the appraisal frameworks which were discussed in Sections 2.1 and 2.2. An appraisal framework has been developed for UK river restoration projects. This framework utilises a range of appraisal techniques as tools to be utilised at various stages of the appraisal framework. This framework takes the catchment as the overall unit for project appraisal, and sees geomorphological and public appraisal as the foundations for a project's development in order to ensure its long-term sustainability. This framework will be returned to throughout the thesis, and will help evaluate existing appraisal techniques and frameworks utilised on UK river restoration projects.

2.4 Conclusion

This chapter has discussed the central role of appraisal in the field of river restoration. In section 2.1 it was seen that EIA forms the backbone of the appraisal structures proposed in the literature, but whilst it offers a guide for structuring appraisals it does not provide enough depth on the individual components of appraisal. Despite the similarities to EIA, it was shown that river restoration appraisal procedures need to be less generic and must be developed to provide the specific components required to appraise river restoration projects effectively. The main components of appraisal were seen to be the need to take the catchment as the basis for appraisal, followed by the inclusion of geomorphological and public appraisal in the development of a project which is sustainable both environmentally and socially.

A range of appropriate appraisal tools were discussed in section 2.2, outlining geomorphological, ecological and public appraisal techniques which are part of a tool box of techniques from which they can be selected and utilised within a broader framework of appraisal. In section 2.3 an idealised appraisal framework was developed and proposed for usage on UK river restoration projects. This framework recognises and describes appraisal as a process which is vital to restoration projects from pre-project reconnaissance surveys and site selection through to post-project appraisal and adaptive management. Within this framework appropriate appraisal techniques can be selected from the toolbox to help in the design and post-project appraisal of the specific project in question.

This proposed model of appraisal will be utilised in the remainder of the thesis as a tool against which to evaluate the practice of appraisal in the UK. In Chapter 4 the range of restoration projects undertaken to date in the UK and their associated appraisal procedures are identified. In this chapter a broad survey allows the techniques and frameworks utilised in practice to be evaluated against those techniques proposed in section 2.2 and the appraisal framework depicted in section 2.3. This enables an evaluation of how far the projects incorporate the three elements of appraisal and the different stages of project appraisal employed.

In Chapters 5 to 7 a regional investigation of the appraisal frameworks based on three case studies is reported. These case studies were evaluated against the appraisal framework proposed in this chapter, enabling the factors which drive and constrain project appraisal to be fully explored. In these chapters focus is placed upon the decision-making process.and the influence that this has on appraisal. In addition, the usage or non-usage of geomorphological and public appraisal techniques are evaluated in detail. In the concluding chapter of this thesis the appraisal framework proposed in this chapter is returned to in order to evaluate the similarities and dissimilarities between this framework and the appraisal frameworks utilised on the three case studies. In addition, this model of appraisal was discussed at a workshop on appraisal (undertaken with river restoration practitioners in November 2002) where workshop attendees were asked to discuss its applicability and whether changes were required. The results of this workshop are discussed and new ideas and recommendations for the appraisal framework are reported in Chapter 8.

The next chapter describes the research methodology for this thesis. It identifies the rationale behind the national and regional investigations, looking at the process of case study identification. The quantitative and qualitative research techniques employed are discussed, and data collection and analysis techniques are explored.

Chapter 3. Research Methodology: a multi-method approach

3.1 Introduction

The purpose of this chapter is to discuss the different research methodologies which were employed to investigate and evaluate the appraisal techniques and appraisal frameworks employed on UK river restoration projects. This research was undertaken in two connected stages. First, a national investigation was undertaken to establish the range of restoration schemes undertaken to date and their accompanying appraisal procedures. This investigation enabled an overall analysis of appraisal techniques employed on restoration projects and the main drivers for river restoration. The techniques and frameworks employed on these projects were then evaluated against the techniques and the appraisal framework established in Chapter 2. Another purpose of this investigation was to set the context for the second stage of research which involved a detailed investigation of the river restoration appraisal techniques and frameworks employed in the Thames region of the EA. The second part of the investigation comprised detailed studies of the appraisal procedures employed on three case study projects. These were a rural and an urban river restoration project (both completed), and an on-going rural project. The techniques and frameworks employed on these three projects were also evaluated against the techniques and the appraisal framework established in Chapter 2. The first investigation provided breadth and a national context. The second investigation provided greater depth, enabling an investigation of the appraisal processes employed on three projects, the nature of the decision-making process and the impacts of decision-making structures and appraisal frameworks upon one another. Combined, the two investigations, enabled an in-depth evaluation of the appraisal techniques and frameworks employed in the UK.

To undertake this research a multi-method approach was utilised. The decision to follow this approach was pragmatically based around the identification of the most suitable techniques available to answer the research questions. This involved the use of a quantitative questionnaire-based approach for the national investigation and a qualitative semi-structured interview-based approach for the regional investigation (focusing on three case studies) alongside the analysis of documents from the EA and other sources.

Multi-method approaches are beneficial in that 'the researcher does not necessarily privilege a particular way of looking at the social world' (Philip, 1998: 261). Also, according to Cook and Crang (1995), multi-method approaches facilitate triangulation, which enables one to cross-refer between data, in order to see how consistent different techniques are, enabling criticism of the quality of one's own data. After some discussion of the institutional context of the research (Section 3.2), Sections 3.3 and 3.4 provide a rationale for the selection of these techniques. These sections also provide a detailed description of how the data collection and analysis techniques were employed, acknowledging some of the limitations of this research.

3.2 Background to ESRC/NERC CASE studentship

This research was undertaken as part of an interdisciplinary ESRC/NERC CASE studentship in partnership with the Thames Region of the EA. The CASE partnership and the interdisciplinary nature of this research influenced the direction this project took. The following section discusses the elements of the research which were required as part of the studentship. The influence that these funding sources had upon this research and the research methodologies utilised is examined as they affected to some extent the manner and nature of the research undertaken.

The EA as CASE partner encouraged the candidate to focus in detail on both geomorphological and public appraisal techniques in both the national and regional investigations because these elements have been identified in the literature as fundamental to river restoration project success (see Chapter 2 Section 2.1.1). Both forms of appraisal were deemed important for the creation of restoration projects which are sustainable in the long-term. The inclusion of geomorphology in river restoration projects is seen to be paramount in the restoration of an appropriate physical structure which can support ecological communities, whilst the inclusion of public opinion in restoration projects was also important for a site's long-term adoption by a local community (see section 2.1 Chapter 2). The requirements of the EA CASE partner dovetailed with the interdisciplinary requirements of the ESRC/NERC funding that the research should cross the boundaries of human and physical geography by, on the one hand, examining the social elements of environmental decision making whilst also exploring the physical elements of river restoration. Additionally, the EA's financial contribution to this research came from funding set aside specifically for geomorphological usage by the EA.

Aside from influencing the focus of the research the nature of funding also influenced the physical locations in which this research was focused. The EA CASE funding emanated from the Thames Region of the EA and a further stipulation of the CASE partner was that the second stage of this research should focus on this region of the EA (see Section 3.4.1). This requirement was rationalised not solely through the fact that this was where the research funding had come from but because this region was deemed (at the time) to be a forerunner in the field of restoration with particular strengths in the usage of geomorphological and public appraisal. Overall, therefore, the project's aims and objectives were shaped but not determined by the sources of funding for the research.

3.3 National Investigation: data collection, analysis and interpretation techniques

In Chapters 1 and 2 it was shown that the appraisal of river restoration projects is a process that has not been well documented in either the policy or practical restoration literature and warrants greater attention due to its importance in project planning, execution and evaluation. The following section first introduces and rationalises the undertaking of a national investigation (Section 3.3.1), and then sets out the data collection (Section 3.3.2) and data analysis (Section 3.3.3) techniques which were used to undertake this investigation.

3.3.1 National Investigation: research rationale

Aims and objectives. The national investigation was undertaken as a broad-based study of the current appraisal techniques employed in the UK, and was carried out by means of a questionnaire survey. The main aim of this investigation was to provide for the first time a characterisation of UK river restoration appraisal procedures. The main objectives were to:

- Establish the range of restoration projects undertaken to date to establish the associated appraisal procedures and techniques utilised on these projects;
- Evaluate how far the appraisal frameworks and techniques employed in practice adhere to the recommendations for undertaking appraisals proposed in policy, practical restoration literature and academic research literature; and
- Identify the constraints to undertaking project appraisals in practice in relation to the constraints to incorporating the appraisal frameworks and techniques proposed in the literature.

This national investigation is pertinent not only in the sense that it is the first attempt to carry out a nation-wide study of appraisal procedures, but also because a more comprehensive understanding of appraisal is needed for river restoration to be undertaken successfully. In the past, research in the field of river restoration has not examined the policy and environmental management dimensions of restoration appraisal procedures. Also, research on appraisal has tended to have a single-disciplinary focus (Clarke *et al.*, 2003), lacking consideration of appraisal as a holistic process (as seen in Chapter 2 and Gardiner, 1991). This national investigation thus aimed to provide knowledge which is much needed but is presently lacking on the current status of appraisal within river restoration. It is on this basis that recommendations for the future can be made.

3.3.2 National Investigation: data collection

Data sources. Conducting the national investigation relied upon the use of two different data sources. First, the RRC's database of UK river restoration projects was interrogated to ascertain what information on appraisal was already in existence and also to draw out broad trends on the nature of river restoration in the UK. Once this investigation was complete a questionnaire survey was developed in order to derive more specific and in-depth information on appraisal which could not be obtained from this source. The RRC database was used as a contact list for all UK river restoration practitioners to whom the questionnaire was sent.

Background to the RRC database and rationale for questionnaire survey. The RRC's database is a comprehensive source of information, containing an up to date list of all river restoration activity undertaken in the UK (see RRC, 1999b). In January 2000 it contained 538 records of river restoration projects. The database records cover all of England and Wales; Scotland (managed by SEPA); Northern Ireland (managed by Rivers Agency, part of Department of Agriculture and Rural Development for Northern Ireland: DARD); and also several key projects undertaken in other countries both within and outside the EU. Each record on the database comprises a brief description of the project's objectives, site background, site location, restoration techniques used, costs, and the people involved in the scheme. The RRC started collecting information for the database in 1998 by use of a very short questionnaire (see Figure 7) sent to the main contact for each project. This database is continually added to and forms an inventory of past, current and planned projects. In 2002 it held over 800 projects. In using this database the limitations of using secondary data sources was acknowledged as 'secondary data reflect the aims and attitudes of the people and organisations who collect the data' (Clark, 1997: 65). However, despite this it is also important to be aware that this data set contains the best available information on river restoration projects in the UK.

The RRC data which were used had been collected by the RRC in order to help them advise river restorers on techniques used in past river restoration projects, or on research undertaken within the UK, and was not intended as an analytical research tool. The records are extremely concise, and the level of detail available is not sufficient to yield adequate information concerning the appraisal process. Only three of the projects listed in the RRC database actually identified appraisal as having taken place, although the Manager of the RRC knew that more projects than this had been subject to some form of assessment (Bruce-Burgess *et al.*, 2000: 3.33). Thus, although the database was useful in terms of gaining a broad picture of the nature of UK river restoration projects, much more detail was required with reference to the appraisal process. As a result, a more detailed and specific questionnaire was required for the second part of this national investigation in order to gain more information on project appraisal. The RRC data were thus used as a preliminary exploratory tool, providing a background to the research and helping design and distribute the questionnaire for the national investigation.

Figure 7. RRC questionnaire and database format

Project Name & Objectives

Main River	Watercourse Name	Site County	Site Country

Location Description ....

OS Sheet Letters .... OS 6 Digit Reference ....

Project Start Date .... Project Status ☐ Proposed
☐ Detail Design Stage
☐ in-contruction
☐ Completed (No Monitoring)
☐ Monitoring

Project Finish Date ....

Project Objectives ....

Main Focus - Driver

☐ Bank Erosion ☐ Development Gain ☐ Flood Defence ☐ Landscape ☐ Pollution Mitigation
☐ Community Demand ☐ Fisheries ☐ Habitat ☐ Navigation ☐ Other...

Source: RRC, 2002b

The RRC's database was utilised initially as a means of establishing the nature and extent of restoration projects employed to date in the UK. The database was subsequently used as a contacts database whereby all those listed on the database were sent a questionnaire on appraisal. At the time that the research was undertaken this was the most up to date list of those involved in river restoration projects in the UK. Members of the RRC visiting the different regions and areas of the EA and gaining information on river restoration projects from different departments had initially constructed the contacts database. The RRC also contacted other organisations, groups and statutory bodies to gain information on projects they had undertaken.

Although the RRC database was used as a contact list for the questionnaire survey it was not taken to be exhaustive. For example, the researcher asked questionnaire respondents to provide information on all restoration projects they were involved in, not solely those listed on the RRC database. Furthermore, those responsible for projects mentioned in the river restoration literature were contacted. This identified 45 additional projects, and the questionnaire was sent to these additional respondents for their completion.

Questionnaire surveys are a commonly used tool in quantitative social research, enabling the examination of the specific characteristics of a target population. One of the critical assumptions of questionnaires is that 'characteristics or beliefs can be described or measured accurately through self-report' (Marshall and Rossman, 1995: 96). Questionnaires have been praised for their generalisability and convenience, enabling one to generate detailed information from which statistical analysis can produce interesting relationships or hypotheses which can be tested. During the first stage of this research questionnaire surveying was selected in order to undertake the national investigation of appraisal techniques. Questionnaire surveying lent itself to the achievement of the research aims and objectives delineated in Section 3.3.1 as it enabled responses to be gathered from a large number of projects within a limited time period. In addition, was also sufficiently in-depth to be able to accurately characterise the overall patterns and nature of appraisal in the UK. In contrast, the second stage of the research required the opposite of this, and thus a qualitative interview-based approach undertaken on a small number of case studies was adopted (see Section 3.4).

(i) Questionnaire design

Two of the main factors controlling questionnaire design were the desire for a high response rate and the requirement that it be executed within a given time period consistent with the research schedule. As a result, the questionnaire was kept short and simple (comprising one page of tick boxes), in order to take up as little of the respondents' time as possible. This was a very important factor given that some respondents were involved in multiple schemes, and would have been less inclined to answer if the questionnaire was longer. The questionnaire's design was also informed by Parfitt's (1997: 85) suggestion that its content should aim to measure what is practicable and relevant to respondents, giving them the maximum opportunity to respond.

The questionnaire was structured into six different sections (see Figure 8). The first two sections of the questionnaire were devised to gain background information for each project. Sections 3-6 aimed to look in detail at the appraisal process, ascertaining whether appraisal was carried out, and at what stages of the project it was undertaken. Section 5 listed a range of appraisal techniques which had either been cited in the literature (see Chapter 2) or utilised by the agencies involved in river restoration in the UK. Section 6 explored the reasons why appraisal may not have been undertaken, and finally a space was left for additional comments so that respondents could enter details or techniques which may not have been included in the questionnaire.

In the questionnaire the term 'appraisal' was left undefined in order to avoid imposing the researcher's own definition upon the respondents, thus allowing them to use their own understanding of appraisal. The decision not to define appraisal was also guided by an interest in finding out other people's understandings of appraisal, enabling investigations of whether activities which were deemed to be forms of appraisal by the researcher were being carried out. This was important as a range of terminology is used to define and describe appraisal. This analysis also enabled the researcher to see whether what she perceived as appraisal was consistent with practitioners' perceptions of appraisal.

Figure 8. National investigation appraisal questionnaire

① **Project Details (File Code: - - - - - -)**

Main contact:

Project name:

Watercourse name:

Urban or Rural:

Start date (D/M/Y): - - / - - / - -

Finish date (D/M/Y): - - / - - / - -

OS sheet letters:

OS 6 digit reference:

(Please complete any gaps, and confirm exact details)

② **What was the primary focus behind the river restoration scheme? And what additional enhancements were carried out?**

Primary focus:

Additional enhancements:

(Please continue overleaf if necessary)

③ **Was the river restoration scheme subject to any form of appraisal?**
(If Yes go to question 4, if No go to question 6).

Yes ❑ No ❑

④ **At what stages of the project was appraisal carried out? (Tick all categories which apply).**

Pre-project ❑ During ❑ Post-project ❑

⑤ **What form did appraisal take? (Tick all categories which apply, and complete any gaps).**

a) Holistic

CBA[1] ❑ Environmental assessment ❑ Landscape assessment ❑
Return monitoring ❑ Site visit ❑

b) Visual

Photos pre-work ❑ Photos post-work ❑

c) Geomorphic

Channel cross-section measurement ❑ Delineation of a reference reach ❑ Geomorphic modelling ❑
Fluvial audit ❑ Fluvial modelling ❑

d) Habitat

HABSCORE ❑ Fisheries survey ❑ PHABSIM/ IFIM ❑
RCS ❑ RHS ❑ RIVPACS ❑
SERCON ❑

e) Public

Discussion groups ❑ Public enquiry ❑ Questionnaire surveys ❑

At what point were the public consulted? ....

f) Pollution

Monitoring of contaminated land ❑ Water quality monitoring ❑

⑥ **If no appraisal was possible please indicate the reason(s) for this (Tick all categories which apply).**

Lack of money ❑ Lack of time ❑ Money diverted elsewhere ❑
No perceived need ❑

In addition to the questionnaire a short but informative covering letter was also compiled to emphasise the importance of this research and its likely outputs. These letters were addressed personally to each individual so that the respondent would know that his/her knowledge was of value to the researcher, and would hopefully secure a higher and faster response rate (see Appendix A for the covering letter).

No pilot study was undertaken prior to the questionnaire's implementation due to the small size of the sampling population. Instead, prior to implementation, the questionnaire's suitability was assessed by the co-ordinator of the original RRC survey (Martin Janes) and the researcher's EA-based CASE supervisor (Richard Copas). Recommended revisions were made to its design and format.

(ii) Questionnaire implementation

A crucial issue in quantitative research is the selection of a sample size and structure which is representative of the population under study. In this research sample size was not an issue because the total population (river restoration projects in the UK) was relatively small and all were to be investigated. A survey of the majority of individuals involved in river restoration was made possible through use of the RRC's database which had contact details for a large proportion of the individuals engaged in river restoration in the UK. Out of the 538 restoration projects listed on the RRC database in January 2000, 440 were sent questionnaires. 98 projects were not sent questionnaires because they were either located outside of the UK or they did not strictly constitute a river restoration project (e.g. the details of a wetland centre were included on the data base). In order to gain responses for these 440 projects 161 people had to be contacted (since individuals were generally involved in more than one project). 147 out of these 161 people were involved in 1-4 projects (total of 228 projects), and 14 people were involved in >5 projects (total of 212 projects). The questionnaires were distributed in two different ways. Those involved in between 1 and 4 projects were sent their questionnaires and a covering letter by post. The remaining people, those involved in five or more projects, were sent a draft of the questionnaire and a covering letter, and one week later were telephoned and a suitable time was set up to discuss their projects face-to-face. For example, one individual was involved in 58 projects, thus arranging an interview was the only way of ensuring a response.

Gaining access to the river restoration community was not a problem in this study because the RRC manager had already given the researcher access to their contact database with a reciprocal agreement that any new information gained and the results of the survey would be made available to the Centre. In addition to this, the purposes of this research and its perceived importance were made clear during the RRC's Annual Network Conference in Manchester (6^{th} April 2000). Most of the questionnaire respondents were present at this meeting and this helped to facilitate co-operation between the researcher and the researched. This also established valuable face-to-face contact with key individuals responsible for river restoration in the UK, and has been of great benefit during all stages of the research.

Respondents were asked to complete the questionnaire within one calendar month (14th March to 14th April 2000). Once the deadline had been reached all non-respondents were sent reminders through the post or by electronic mail. Once three reminders had been dispatched and a telephone enquiry made it was assumed that the remaining non-respondents would not answer the questionnaire and a phase of data analysis was embarked upon. An 80% response rate was achieved from this questionnaire (with 129 people responding with information on 287 projects). 68 projects were carried out by 68 individuals, 192 projects were carried out by 38 people (thus 38 people were responsible for more than one project), and information for 27 projects were found in reference sources (e.g. EA, 1998a; and Ward *et al.,* 1995). It is anticipated that the reason for such a high response may have been related to the concise design of the questionnaire, but also because practitioners perceived both project appraisal and this research to be important as the details of the research had been highlighted at the above-mentioned RRC conference. The 20% non-response rate meant that 153 projects remained unaccounted for, although there was no discernible pattern related to reason for non-response and examination of the omissions did not show any specific trends which could bias the results.

3.3.3 National Investigation: data analysis and interpretation

As was explained earlier, this national investigation utilised two data sources: RRC data and questionnaire data. This meant that data analysis was undertaken in two separate phases using different techniques. The RRC data were analysed in less detail than the questionnaire survey, as the sole purpose of this analysis was to provide a background context for the questionnaire survey. The questionnaire survey was rigorously analysed using descriptive statistics in order to characterise the nature of appraisal in the UK. The data were further analysed to ascertain to what extent projects incorporated the principles of appraisal and the components of the appraisal framework set out in chapter 2. The techniques used in the analysis of these two separate sources of data are now individually examined.

(i) RRC data: analysis and interpretation

Analysis of the existing data in the RRC database was carried out in Microsoft *Excel* (Version 1997, SR-2). This provided a broad picture of UK river restoration projects, and established gaps in the data which needed filling during the national-scale questionnaire survey. This analysis was a precursor to the questionnaire and helped to inform its design, ensuring that the questionnaire survey did not replicate data already collected by the RRC.

Spatial spread of river restoration projects. Preliminary data analysis involved the use of descriptive statistics to show national and regional river restoration trends, therefore establishing the different regional geographic concentrations of river restoration projects in the UK.

Keyword search 1: project definition. Each project on the RRC database possessed a short piece of text detailing the scheme's objectives. This short statement was used during three keyword searches of the data. The first keyword search simply quantified the different nouns used to describe each project (e.g. restoration, rehabilitation, enhancement and creation). The purpose of this was to see which terms were favoured by practitioners in the light of the academic debates surrounding the definition of restoration (see Chapter 1). During this early stage of analysis, the database was explored for the presence of the term 'appraisal.'

Keyword search 2: project focus. As was seen in Figure 7, the RRC database collects information on each project's main focus with eleven options to choose from (1. bank erosion; 2. community demand; 3. development gain; 4. fisheries; 5. flood defence; 6. habitat; 7. landscape; 8. navigation; 9. pollution mitigation; 10. opportunistic; and 11. Other). These eleven options were used in a second keyword search to analyse and explain the main focus of projects both nationally and regionally. In cases where respondents selected more than one option as a main focus, it was assumed that the first option mentioned was the project's main focus and the others were ancillary.

Keyword search 3: restoration techniques. The final keyword search explored in greater detail each project's text (stored in the RRC's database), and drew out the different restoration techniques used by practitioners. In this keyword search each project was placed into one of the following categories: 1. geomorphology/hydrology; 2. ecology/habitat; 3. pollution mitigation; 4. agricultural; 5. public and 6. other. These six categories were selected after a thorough examination of each project's text description, whereby the restoration techniques used were extracted and classified into these categories. The categorisation of restoration techniques into these six classes (Table 13) allowed projects to be examined in greater detail since each category is composed of sub-categories which were self-selecting from each project's text description in the database. The selection of these categories was also informed by the understanding that the inclusion of geomorphology, ecology and public participation in river restoration is vital to a project's long-term sustainability. Although it is acknowledged that this classification does have limitations, it was deemed to be satisfactory for this preliminary data analysis as its sole purpose was to provide a descriptive background to the questionnaire survey and its analysis.

The three keyword searches helped to draw out information on the appraisal techniques employed. It was thus possible to evaluate the extent to which project appraisal was undertaken on a catchment basis and included geomorphological and public appraisal (as specified in Chapter 2). It was also possible to examine the different phases of appraisal and evaluate these against the proposed appraisal framework delineated in Chapter 2.

Table 13. Description of categories and sub-categories used in key-word search 2

Geomorphology	Agricultural
•Flood alleviation/ mitigation/ control/ defence •Channel maintenance work (e.g. partial dredging) •Reinstatement of channel geometry, riffle-pool sequence •River diversion (weirs, deflectors, boulders, debris, gabions) •Resizing of channel (narrowing, widening) •Sediment introduction (in-stream structures) •Flood storage (water control structures) •Flow alteration •Reduce erosion •Removal or modification of impoundments •Restore connectivity between river and floodplain •Replace concrete channel with natural channel •Restore in-channel geomorphic diversity •Reprofiling •Meander recreation (restoration of sinuosity or bends) •Restore water levels •Bioengineering using geotextiles •Backwater creation •Fencing	•Buffer zone creation •Conversion of farmland to ameliorate habitat potential, environmentally sensitive farming •Grants aid/advice •Improve/create cattle crossings •Reduce grazing or access by cattle •Increase grazing
Habitat	**Public**
•Provide cover for fish and aquatic organisms • Introduce fish ladders or passes •Enhance fish stocks and aquatic habitats •Restore riparian zone for habitat enhancement/ river corridor creation •Bank stabilisation and protection with plants •Wetland/wet meadow/ water meadow creation or restoration •Restore plant habitat diversity •SSSI protection •Recreate various mammal/wildlife habitats •Reed bed planting/ also willow and alder •Restore general habitat diversity •Creation of bird habitats •Protect existing heritage •Hedgerow restoration •Restore woodland or forest/ tree planting •Pond/lake/scrape/ditch/fen/island creation or restoration	•Enhancement for recreation and amenity purposes (community benefit) •Increase public awareness •Create and educational resource •Path-widening/ stabilisation for pedestrians, footbridges, benches, towpaths •Improve public access •Creation of platforms for anglers •Creation of mooring area for boats •Working with local people/ community based
Pollution mitigation	**Other**
•Improve water quality •Pollution mitigation, use of natural buffers •Clean-up contaminated land •Removal of litter •Channel dredging, remove dumped objects •Reduce chemical run-off from agriculture	•Increase river's economic value for local community/ local businesses/ tourism •Landscape amelioration •Creation of a sustainable river system •Monitoring/appraisal •Project at proposal stage

(ii) Questionnaire survey data: analysis and interpretation

The focus of the questionnaire survey was on the appraisal techniques employed on UK river restoration projects. The purpose of this survey was to quantify the extent of appraisal and the techniques deployed.

Data entry and processing. As the appraisal questionnaires were returned they were given individual serial codes and then entered into a database created in Microsoft *Access* (Version 1997, SR-2). The use of a database ensured that the data were entered systematically, reducing the chances of typing errors, it also enabled data to be displayed clearly. Clarity was very important as copies of the data were going to be made available to the RRC and the EA, thus the data needed to be legible by other individuals aside from the researcher. In addition to the questionnaire, respondents also sometimes provided additional information (e.g. in the form of leaflets or academic papers). In such instances the information was entered into a Microsoft *Word* (Version 1997, SR-2) file which corresponded to the project in question. This was then linked and cross-referenced with the *Access* database. Although *Access* was used for data storage the researcher decided to use *Excel* for data analysis, due to greater familiarity with this package. Once exported from *Access* into *Excel* the survey data were coded numerically (e.g. 'Yes/No' statements were numerically converted to 1 for 'Yes' and 0 for 'No') to enable responses to be quantified. Textual responses were coded in a more detailed manner.

Descriptive data analysis. Preliminary analysis of the survey data involved the use of descriptive statistics to help elucidate national and regional appraisal trends, establishing the different regional concentrations of appraisal, the different stages of appraisal, the appraisal techniques utilised, and reasons for not undertaking an appraisal. The analysis of these data also acted as a backdrop to a more detailed textual analysis of each project in general, and an evaluation of each project's achievement of the three components of river restoration described in chapter 2.

Textual data analysis. The textual analysis of the questionnaire data extended the keyword search approach used in the analysis of the RRC data, providing a greater level of detail on the types of project undertaken. In the questionnaire, respondents were asked to define the main focus of their project through a short textual description, followed by a description of additional enhancements which were peripheral to their primary foci. To draw out the trends from this textual data it was first coded. It was decided that the categories used in the analysis of the RRC data were not suitable for the analysis of the survey data, as the previous categories had been selected purely to be analogous to the set-up of the RRC's database (as seen in Figure 7). As a result, thirteen new categories were developed (Table 14). These categories emerged from the analysis of the questionnaire responses. This coding facility enabled each project to be classified based on its primary focus, providing a national and regional breakdown of all restoration projects' primary foci. In instances where projects had more than one focus, the first focus mentioned was assumed to be the project's main focus. The secondary focus of projects was also briefly explored, in order to quantify whether certain elements of restoration which had been identified in the literature as rarely undertaken (e.g. public participation and geomorphology) were given lower priority than other components (e.g. ecology) which have been seen to be favoured by practitioners.

Table 14. Thirteen new categories developed to analyse the questionnaire survey

1) Flood alleviation/defence
2) Geomorphology
3) Bank work
4) Hydrology/flow
5) Fisheries
6) Land development (e.g. housing)
7) Erosion control
8) Habitat improvements
9) Landscaping
10) Water quality
11) Amenity
12) Environmental management plan
13) Other

Data interpretation. The data were interpreted across national and regional spatial scales, and described within each region's socio-political and landscape context. The appraisal techniques employed were then examined in relation to the river restoration regional trends derived from the analysis of the RRC database. Projects were also subdivided into urban or rural categories and examined to see if any differences existed between these categories in terms of the restoration and appraisal techniques employed.

This data analysis also enabled the researcher to evaluate the extent to which projects took a catchment basis and whether they incorporated geomorphological and public appraisal. In addition, it also enabled a preliminary evaluation of how far project appraisal resembled the appraisal framework depicted in Chapter 2 and the different stages of appraisal employed.

These two stages of data analysis (RRC data and questionnaire data) also provided the context for the more detailed qualitative survey of three river restoration case studies located in the Thames region of the EA. While the national investigation provided a wide breadth of descriptive information, the regional investigation provided greater explanatory depth.

3.4 Regional Investigation: data collection, analysis and interpretation techniques

The following section discusses the regional investigation, first introducing and rationalising its undertaking (Section 3.4.1), then setting out the data collection (Section 3.4.2) and data analysis (Section 3.4.3) techniques which were used.

3.4.1 Regional Investigation: research rationale

Aims and objectives. The main aim of the detailed study of the Thames region of the EA was to examine the policy and practice of project appraisal and decision making in that region. This regional investigation differed from the national investigation as it provided a depth not achievable through semi-quantitative questionnaire surveying alone, instead focusing in depth on three case study river restoration projects. The objectives of the regional investigation were to:

- Evaluate the regional policies and practices regarding project appraisal within the Thames region of the EA;
- Evaluate the appraisal procedures employed on three recently-completed restoration schemes, in order to examine how far the appraisal procedures employed in practice adhered to the recommendations for undertaking appraisals proposed in policy and practical restoration literature;
- Evaluate the appraisal techniques employed on these three restoration schemes, with emphasis on geomorphological and public participation techniques, to examine how far the techniques employed in practice adhered to the recommendations proposed in the literature; and to
- Evaluate the decision-making structures employed on each scheme, including an examination of how far individuals with different disciplinary and institutional backgrounds influenced a project's appraisal framework and trajectory.

The regional investigation also focused in greater detail on geomorphological and public appraisal techniques than was possible in the national investigation. This investigation utilised three case studies: one completed rural river restoration project, one completed urban river restoration project and one on-going rural river restoration project.

Rationale for the Thames Region focus. The Thames region of the EA was focused on during this study for a range of reasons:

- The national investigation indicated that this region had undertaken the greatest number of river restoration projects in the whole of the UK;
- The region has a history of taking holistic approaches to river management;
- The region has a history of including geomorphological and public appraisal in river restoration projects; and also
- For pragmatic reasons as this research was CASE funded and supervised by the EA Thames region (see above).

In the 1980s, the Thames region of the EA (then Thames Water Authority see Map 1) developed a new holistic and multidisciplinary approach to river management unique to the UK water industry. Gardiner (1991) pioneered both the development and incorporation of project appraisal in river management within this region, and also the development of catchment-based management planning as part of a holistic framework for river management. Gardiner's (1991) manual on appraisal gave advice on all elements of appraisal, making clear that successful river restoration needed to be nested in comprehensive and on-going appraisal, taking account of all stakeholders' views. This structured approach to appraisal was, and is still, unique to Thames region, and since this period the Thames region has placed particular importance on public involvement in decision making – through the commissioning of Middlesex University's Flood Hazard Research Centre (FHRC) – and the inclusion of geomorphological principles in restoration design. This region is the only region of the EA which possesses a centre for geomorphological advice (see Brookes, 1995).

Map 1. Eight regions of the UK EA

Source: adapted from EA, 1996: 28

This region's strength in the field of environmental appraisal was also heightened following the formation of the RRC. In 1998 the Thames region funded the RRC to undertake 20 audits of projects carried out since 1989, ranging from small enhancements to more complex restoration schemes. These audits helped to delineate areas of good practice within the region and areas where problems were arising.

The Thames region was also focused upon for pragmatic reasons as the researcher's host institution was located within Greater London. Also, the RRC, with whom this research was closely associated, is also located in the Thames region, enabling rapid access to sources of information stored at the EA and RRC, whilst also facilitating easy access to case study sites selected for this regional investigation. Map 1 depicts the location of this region with respect to the other seven EA regions.

3.4.2 Case study selection rationale

Case studies involve the examination and analysis of a particular event or decision within a specific setting (Kitchen and Tate, 2000: 225; and Thomas, 1998: 307). They are by nature specific, and enable issues to be studied in depth. According to Thomas (1998: 307 and 321), they can be used to help understand causal processes, interrelationships and inner workings, such as why and how a decision or set of decisions were made, and what the consequences of these decisions were. In this instance, case studies were employed to collect detailed data on appraisal processes and techniques, which would provide a greater depth of understanding than was possible through the national investigation. A case study approach enabled the researcher to examine the decision-making structures and appraisal structures utilised on three projects and to evaluate the effects of one upon the other. At its most detailed level the case studies enabled the examination of the roles of individual decision makers within each project. This provided a depth of analysis not possible through the national survey, as the national survey only provided a broad overview of the nature and extent of appraisal, and did not focus upon the individual factors which drive and constrain appraisal. The case study approach therefore enabled the appraisal process to be understood within the context of regional and national policy, and enabled theoretical generalisations to be drawn (Thomas, 1998: 323) by evaluating the appraisal structures utilised against the framework proposed in Chapter 2.

The selection of appropriate case studies was a comprehensive and strategic process. At the outset it was decided to concentrate on three specific sites, involving one site in an urban location, one in a rural location and a third on-going project. The rationale for selecting these three different types of project was to see how appraisal procedures differed across projects, and to highlight the prevalence of different sets of perceived issues (which had been discussed in the literature) between urban and rural locations. The purpose of the on-going project was to act as a means of capturing the dynamism inherent in projects, and to observe the logic used during decision making. From the knowledge gained during the national investigation, interrogation of the RRC database, and an extensive literature review the author was in a position to see which sites would make potentially valuable case studies. Thus, case studies were selected on the basis of whether they:

- Had undergone appraisal;
- Had included public consultation in their appraisal;
- Had included geomorphology in their appraisal; and
- Were located in the Thames region.

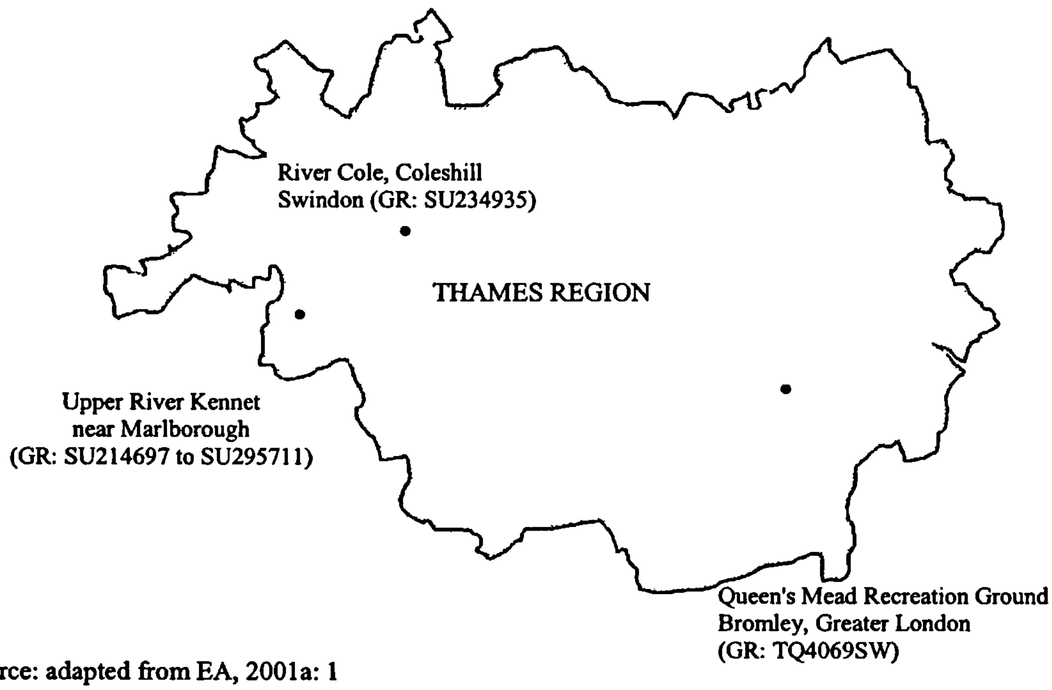
This strategic site selection approach was chosen over a random approach, because it ensured that sites which would not yield information on the above criteria were ignored, and sites which did include these elements were selected. Additionally, the national investigation had already collected data on small-scale projects within Thames Region which were representative of the majority of projects. An absolute list of all river restoration projects in Thames Region was used for site selection (see Appendix B). Once all non-appraised projects and short-term projects had been eliminated from this list, then the remaining list was split into categories of urban and rural, and a score of 1 was given to each project for its achievement of each of the criteria discussed above. Each project's score was totalled, and those that gained a score of 4 were seen as potential sites for selection. This list (see Table 15) was then sub-divided into 'urban', 'rural', and 'on-going' categories, and sites were selected from this list.

Urban case study selection. In terms of the urban case study, site selection was more difficult than the rural and on-going project, as more options achieved a score of 4. The river Ravensbourne at Bromley Golf Course and the Kyd Brook deculverting at Sunbridge Park golf course were both omitted following a discussion with the EA co-ordinator for these projects as neither project had strong geomorphological or public participation components. The Crane park island project was eliminated as an option because it was not specifically a restoration project, it involved ecological enhancement works to an island. Similarly, the restoration of the river Bulbourne was dropped as it focused to a greater degree on wetland restoration as opposed to river restoration. This left the River Wye (High Wycombe) and Queen's Mead Recreation Ground (QMRG) on the Ravensbourne as prime candidates for the urban site. The researcher was particularly keen to use the Ravensbourne catchment as a case study due to knowledge of public perception work which had been undertaken there. Finally, the fact that an extensive archive of material existed for this river meant that it was chosen over the Wye project. The Ravensbourne project (Map 2) was also selected because it was a partnership project between the EA and London Borough of Bromley, with input from numerous consultants and the local community and thus had an interesting decision-making structure.

Table 15. Case study site options

Project name	Appraised	Public	Geomorphological	Total score
Rural options:				
Cole: Coleshill, Swindon	✓	✓	✓	4
Urban options:				
Wye: High Wycombe	✓	✓	✓	4
Ravensbourne: Queensmead, Bromley	✓	✓	✓	4
Ravensbourne: Bromley Golf Course	✓	✓	✓	4
Kyd Brook: Sunbridge park golf course	✓	✓	✓	4
Crane: Crane park island	✓	✓	✓	4
Bulbourne	✓	✓	✓	4
On-going options:				
Upper Kennet: Marlborough (in progress)	✓	✓	✓	4
Brent: Wembley, enhancement project (in progress)	✓	✓	✓	4

Map 2. The Thames region of the EA, and the location of the three case study sites



Source: adapted from EA, 2001a: 1

Rural case study selection. The list of potential rural sites was reduced to one following the final stage of project elimination. One reason for this was the high rate of urbanisation in the Thames region. Another reason was that fewer rural river restoration projects have been undertaken. The rural options were narrowed down to two sites, the Cole River Restoration project (CRRP) and the Upper Kennet Rehabilitation Project (UKRP). The Cole was chosen over the Kennet because the Kennet was an on-going project, whereas the Cole had been completed. Additionally, the Cole had undergone an extensive and structured planning process and seemed to fulfil all the criteria which were deemed important in the case study. However, because the Kennet project was in progress as opposed to completed it was decided that the Cole was the best option for an example of a rural completed case study. The rural Cole River Restoration Project (Map 2) was also an interesting project because it was undertaken by the RRP (now RRC) and a wide range of river restoration experts (academics and practitioners) as it was one of three EU Life river restoration demonstration initiatives (The other two sister projects were on an urban reach of the River Skerne (Darlington) and on a rural reach of the River Brede (South Jutland, Denmark), see Hoffman *et al.*, 1998). The unusual decision-making structure on this project also made it an interesting case study. In addition, the project has also been identified as one of the most heavily monitored river restoration sites in the world thus making it a strong candidate case study for an analysis of appraisal.

On-going case study selection. The Brent restoration project in Wembley and the Upper Kennet Rehabilitation Project were the only two options available for on-going projects. The Brent had had extensive appraisal of numerous parameters, however, at the time of study it was still in a feasibility stage and it was not certain that it would actually go ahead. The Kennet, on the other hand, had got past the feasibility stage, had had pre-project baseline surveys undertaken and was being undertaken within the time scale of this research project. The chalk stream based Upper Kennet Rehabilitation Project (Map 2) was also deemed interesting in terms of decision-making structures in that it was a partnership project between Thames Water (TW), the EA, English Nature, Wiltshire Wildlife Trust and a local pressure group Action for the River Kennet. The Upper Kennet Rehabilitation Project was initiated following a public inquiry into TW's groundwater abstractions.

Once these sites had been selected, the RRC project board (which includes leading experts in the field of river restoration) and the researcher's EA CASE supervisor were consulted in order to ascertain their views on the suitability of the three proposed case studies. This gave them the opportunity to suggest alternative sites or to express concern over the sites which had been selected. Consensus was reached over the chosen sites, and the researcher's EA CASE supervisor and the RRC agreed to act as gatekeepers enabling the researcher to gain more rapid contact with interviewees and enabling open access to archive material housed at the EA Thames region and the RRC.

3.4.3 Regional Investigation: data collection

Data sources and rationale for their selection. The investigation of the Thames region focused on the use of two sources of data: interviews and archival material. Interviews were undertaken because they enabled the researcher to undertake an in-depth analysis of the appraisal procedures employed on each case study. Interviewing as a research methodology differs substantially from questionnaire surveying, as it is a non-standardised means of obtaining information on 'experiences, feelings or opinions' (Kitchen and Tate, 2000: 213). For Valentine (1997: 111), interviews are beneficial in that they are sensitive and people-oriented, allowing interviewees to construct their own accounts of their experiences by describing and explaining their lives in their own words, relying upon meanings rather than statistics. In this investigation interviewing enabled information on decision-making processes to be uncovered and enabled a greater depth of information to be yielded than was possible through the national investigation. Interviewing also enabled the researcher to establish each project's range of policies and practices, recording and analysing appraisal structures, decision-making structures, where and how successes were achieved, where and why difficulties were encountered, whilst also documenting emerging ideas on good practice.

A semi-structured approach to interviewing was selected, and was based on a broad list of topics or themes (the interview guide) which the interviewer wished the respondent to talk about (Fielding, 1993: 136). The semi-structured interview was selected as it gave respondents 'more scope for elaboration and general discussion rather than just being presented with a set of fixed questions demanding only fixed responses' (Robinson, 1998: 413). According to Palmer, whilst semi-structured interviews give the appearance of being a natural conversation they are in fact very much controlled and directed towards the interviewer's research interests (Palmer, 1928: 171: in Burgess, 1982: 107). This technique suited this study as it enabled the interviewer to probe deeper, and to follow up in greater detail interesting paths that emerged which were specific to the context of the individual case study or the interviewee.

This investigation of the Thames region also involved the analysis of published documents, official documents and memoranda held by the EA and the RRC. These documents helped to understand the processes, ideas and the decision making which each site underwent during restoration, providing a theoretical and technical background to the interview material.

(i) Interview design

Prior to undertaking the interviews, an interview guide was compiled to help structure the interviews (see Table 16). Semi-structured interviews do not follow distinct structures or ask predetermined questions. However, the literature does recommend the use of a guide to help keep the interview focused, and to enable all necessary information to be gained, yielding answers to research questions (see Robinson, 1998: 414). The interview guide for this research was subdivided into five different sections, and each section possessed a series of pointers which were used to focus the interview. The first section of the interview guide ascertained the personal details of the interviewee, followed by background information on the project (e.g. the interviewee's role in the project). The third section examined definitions, whether goals and objectives were clearly defined, and the manner in which restoration or rehabilitation was defined. The fourth section of the interview guide considered the appraisal techniques which were used, asking the respondent to describe what he/she felt the appraisal process consisted of. This section enabled the decision-making process and project design to be understood. The final section examined constraints on appraisal. These themes and pointers were not necessarily asked as direct questions. They were used to ensure that the interview was keeping on course and that no vital information was omitted. Each interview was very individual, thus questions not found on the guide were also asked in order to tailor the questions towards the individual interviewee. The RRC and the researcher's EA CASE supervisor made comments on the interview guide prior to its implementation, and recommended changes were then made.

Table 16. Interview guide

Section A: Personal details
1. Name
2. Organisation working for
3. Job title
Section B: Background information
Please could you briefly explain your role in project X.
4. At what stage you came on-board the project team
5. The duration of your stay on the project team
6. And the type of knowledge and background you brought to the project (e.g. past experience, qualifications, and expertise in a specific field).
Section C: Definitions of restoration/rehabilitation
Were the project's aims and objectives clearly defined?
7. And at what stage of the project were these definitions made? (Pre project, after the project had started, not defined).
Was restoration/rehabilitation clearly defined for this project? (e.g. pre-disturbance, pre-channelisation....).
8. Was this definition the same as your personal definition of restoration/rehabilitation?
9. How important do you think the definition of restoration/rehabilitation is in planning a project, and setting out its aims and objectives?
10. Was appraisal an important aspect of the project?
Section D: Appraisal techniques used. Answer 11-20 if you are appraiser, else 20.
Please could you describe the structure/components of the appraisal process (from initial project outline, collection of baseline surveys, throughout construction, project completion, and post project monitoring, also indicating the appraisal techniques used).
11. Who decided which appraisal techniques should be used?
12. If it was not you who selected the technique, did you agree with the technique which was selected? If no, what in your opinion would have been a more suitable alternative, and why? What are the advantages and disadvantages of the chosen technique?
13. If several techniques were used at what stages of the project were they carried out?
14. What was the sample size and frequency of sampling, how were the sample point selected?
15. Were the same sample points used again in post-project monitoring?
16. How was the time period selected for project completion?
17. How was the post-project monitoring time period selected?
18. How will/was the data from the appraisal be used (a means of gauging success/failure, a means of quality control so changes can be made as project proceeds to fine-tune the process).
19. If appraisal is used as a means of refining the project are the projects aims and objectives restructured each time a change is made to the technique?
20. If you were not the appraiser, were the techniques you used carried out as part of a vision/ plan.
Section E: Constraints
What were the constraints on appraisal (money, time...)?
21. Was everything that you deemed important appraised? or were certain aspects omitted?
if so how was it decided to omit one aspect over the other? (how was the decision made).
22. Did the manner in which restoration was defined help to focus/structure the appraisal process?
23. If money, time and bureaucracy/policy were not an issue, what would be your ideal form of appraisal?
24. Was there conflicting ideas on how appraisal should be undertaken between groups?
25. Did the project manager's background bias the way in which restoration is carried out?
26. In retrospect would you carry out the appraisal the same way again?

(ii) Interview implementation

Selecting interviewees. In order for interviews to yield the information required to address a particular research question it is necessary to select people for interview who will help achieve research goals. Thus choosing who to interview is often a theoretically motivated decision, seeking an illustrative (not simply a representative) sample (Valentine, 1997: 112). For all of the three case studies it was possible to draw up an absolute list of all individuals involved in each project, and from this list the key individuals who needed to be interviewed were selected. The selection of these individuals involved a process of elimination whereby people who had not played a part in project design or appraisal were eliminated. Additionally, individuals on the list who were no longer contactable (e.g. no longer working for the EA, retired or had moved away) were eliminated following failed attempts to contact them. This elimination process was also undertaken with the help of the manager of the RRC and the researcher's EA CASE supervisor. During the process of interviewing the researcher remained open to suggestions from her interviewees as some proposed further individuals to interview.

In total 25 interviews were undertaken (see Table 17): nine on the Queen's Mead Recreation Ground; twelve on the Cole River Restoration project; and four on the Upper Kennet Rehabilitation Project. On the Upper Kennet Rehabilitation Project, TW were under pressure (temporally and monetarily) to complete the project which had already been stalled by the outbreak of foot-and-mouth and the onset of the floods in Autumn 2000. As a result, TW decided to limit the number of interviews which the researcher could undertake. This meant that the researcher undertook four in-depth interviews with four key interviewees. Although this situation was not ideal, at this stage the researcher did not have another on-going project to revert to (as the Brent's future was uncertain). As a result, the Upper Kennet Rehabilitation Project was proceeded with and its limitations accepted.

Selecting an interview order. The case studies were undertaken sequentially (Queen's Mead Recreation Ground, Cole River Restoration project and then Upper Kennet Rehabilitation Project) between Autumn 2000 and Spring 2001. Archival material was first consulted in order to gain adequate background knowledge and to help understand how each interviewee fitted into the project and their specific roles. Interviews were then set up using the researcher's gatekeepers who facilitated access to contact details for each interviewee, and in some cases spoke to potential interviewees on the researcher's behalf. This made it possible to interview certain respondents to whom access would usually be denied or be difficult to gain. Once the complete list of interviewees was compiled they were contacted first by mail and then by telephone and dates were set for interviews. All proposed interviewees agreed to be interviewed.

Table 17. List of interviewees for all three case studies

Site	Role
QMRG	
Richard Copas, EA	Landscape architect
Adrian Meadley, EA	Project manager
Bromley Borough Council, project partners	Project manager
Andrew Brookes, EA	Geomorphologist
Sylvia Tunstall and Sue Tapsell. FHRC, Middlesex University	Public perception work
Andy Pepper, ATPEC consultancy	Hydrological engineer
Kevin Patrick, Hankinson and Duckets consultancy	Project manager
Dr Maureen Fordham, Anglia University Polytechnic	Public perception work
CRRP	
Jeremy Biggs, Pond Action UK	Responsible for all monitoring work
Richard Morriss, Estates manager for National Trust	Consulted with tenant farmers
Keith Blaxor, Senior Warden, Coleshill estate	Consulted with tenant farmers
Karen Fisher, HR Wallingford	Hydrological modelling
David Sear, Southampton University	Geomorphological work
Nigel Holmes, Alconbury environmental consultants	Member of RRP board member
Martin Janes, River Restoration Centre manager	Project manager
Richard Vivash, Riverscape consultancy	Engineer
Richard Copas, EA	Landscape architect
Alastair Driver, EA Thames region	Conservation Officer
Sylvia Tunstall. FHRC, Middlesex University	Public perception work
Sue Tapsell. FHRC, Middlesex University	Public perception work
UKRP	
Nigel Holmes, Alconbury environmental consultants	Project director
Kevin Patrick, Hankinson and Duckets consultancy	Project manager
Mike Crafer, TW	Ecologist
Yvette De Garis, TW	Project manager

Interview location. Selection of an interview location is an important aspect of qualitative research since it is an embodiment of multiple scales of spatial relations and meaning which have a bearing on both the positionality of the participant and the participant's interaction with the interviewer (Elwood and Martin, 2000: 649). During this research these issues were borne in mind and the majority of the interviews were undertaken within a formal setting, either within the interviewee's office or in a conference room which had been reserved for the occasion. In one instance an interview was undertaken within a respondent's home (as this was his place of work), and in another instance the interview was undertaken next to a river (to fit into an interviewee's tight schedule). The interview locations reflected the easiest and least time consuming option for the interviewee. Although it is acknowledged that different responses may have been elicited had the interviews been undertaken in less formal locations, the selection of location reflected the practical need to minimise the amount of time taken from each interviewee's working day.

Undertaking the interviews. Interviews were undertaken using the interview guide described earlier, and the duration of the interviews varied from half an hour to an hour and a half. The interviews were tape-recorded rather than being recorded by hand which helped keep the duration of the interview to a minimum. Notes were also taken during the interview, and immediately after the interview an account of the interview experience was written to help later analysis and help the researcher to remember the interview more clearly at a later date (especially if the tape recording was unclear). Each interview was then transcribed word for word at the earliest possible date following the interview. During all stages of her research, the researcher remained aware of her positionality, as recommended by McDowell (1998), England (1994) and Valentine (1997).

3.4.4 Regional Investigation: data analysis and interpretation

(i) Data codification

Qualitative data analysis is often a daunting prospect because unlike quantitative data analysis it 'lacks the formal rigour of standardised procedures' (Kitchen and Tate, 2000: 228). In an attempt to overcome these analytical difficulties various techniques and approaches have been developed to contend with analysis of what often constitutes vast quantities of material. It has now become standard practice amongst social scientists to transcribe and annotate all interview information into script form. This script can then be used as record of the interview process and can be subject to analysis through the use of theoretical or language-based codes.

In this research interview material was first transcribed and then archival material was collated, both were then coded. In this instance codes were systematically developed by looking at the research aims for this stage of research, by examining the interview prompt sheet, and by categorising and sub-categorising all questions asked by the researcher during each interview. Through the reading of the interview transcripts, themes, issues and questions which the interviewees brought up were drawn-out. Eight different coding themes were created to help analyse the interview material. These were: 1. project/site background; 2. decision-making team; 3. decision-making structure; 4. appraisal structure; 5. project financing; 6. project constraints; 7. retrospective changes and lessons learnt and 8. the future (initially ten codes were created see Appendix C for more detail of all codes and sub-codes used). The national investigation also informed the development of these codes. For example, in this investigation project financing was seen to influence and constrain project development and appraisal so this was thus included as a code in the interview analysis.

(ii) Data interpretation

Once the interviews and archive material had been coded, it was then possible to organise the material into specific themes and to extract what was meaningful and significant in relation to specific research aims. This enabled a detailed examination of each project's decision-making structure and appraisal structure, evaluating the influence of one upon the other. Each individual project's appraisal structure was also evaluated against the appraisal framework delineated in

Chapter 2, identifying factors which influence and constrain project appraisal and examining how far ideas proposed in the literature can be realistically applied on the ground.

The appraisal techniques employed were also evaluated with particular focus on geomorphological and public appraisal techniques. The extent to which projects utilised the catchment as the wider context within which to plan and execute a project was also examined. The geomorphological and public appraisal techniques employed were evaluated against those techniques depicted in Chapter 2.

3.5 Conclusion

This chapter has documented the different research methodologies and analysis techniques employed in the national and regional investigations. As with all research one can always look back with hindsight and see flaws in the original research design, identifying problems and limitations, and improvements that one would make if one was to repeat the research.

Critique of national investigation methodology. In relation to the national investigation, the questionnaire's design could have benefited from the inclusion of some additional tick boxes. For example, it would have been particularly interesting to include a statement on the total budget allocated for the project in order to see whether appraisal and the depth of a project were directly related to economic constraints. The researcher would also have benefited from more information on the geomorphological techniques employed, although at the time a need to balance a wide range of different techniques in Section 5 of the questionnaire was felt to be necessary so as to not bias one form of appraisal over others. Additionally, a more descriptive question on what respondents understood by the term appraisal would have been interesting, because undoubtedly what respondents understood appraisal to mean influenced which boxes they ticked on the questionnaire. The researcher had decided not to undertake a pilot study based upon the fact that the total population of respondents was relatively small. However, in hindsight a pilot study may have led to the incorporation of the questions detailed above which would have provided a more detailed picture of the nature of project appraisal in the UK.

Critique of regional investigation methodology. If the regional investigation was to be undertaken again the researcher may have favoured the selection of different sites, though it is acknowledged that the sites selected showed interesting appraisal and decision-making structures. Although the case studies selected were interesting and helped depict the complexities of the appraisal process they were also limiting. For example, on the Upper Kennet Rehabilitation Project the researcher was restricted to only undertaking four interviews, when realistically she would have preferred to have undertaken more. Also on the Queen's Mead Recreation Ground project, although not restricting in terms of numbers of interviews undertaken, it was of limited use as although subject to much pre-project appraisal it had not yet been physically undertaken due to the physical constraints associated with the site. Having said this, Queen's Mead Recreation Ground was interesting in its own right, as it helped identify real reasons why projects become stalled, and depicted the sorts of constraints within which projects are undertaken. On a practical note, the researcher also felt that her interviewing technique improved substantially as time passed. Thus she felt that she obtained a greater depth and quality of data from the later interviews. This may have affected the depth of data obtained for earlier case studies, though use of an interview schedule throughout ensured that the same themes were consistently covered in all interviews.

The following chapter examines the results of the first stage of this research (the national investigation). This chapter characterises the nature of river restoration and appraisal in the UK, through a literature review and an analysis of the RRC's data and the questionnaire survey discussed in Section 3.3.

Chapter 4. National Investigation of river restoration appraisal techniques

4.1 Introduction

Rivers in the UK have long been manipulated to facilitate urban and agricultural expansion. The character of the UK's rivers has been much influenced by the industrial revolution (Petts *et al.*, 2002: 1), and by the country's long history of land drainage (documented by Purseglove, 1989) which began as early as Roman times and expanded in the 17th century. During this period floodplains and wetlands were seen as inhospitable wastelands to be 'tamed', and a series of acts of parliament were passed enabling vast areas of land to be drained to increase agricultural productivity (see Table 18). The pace of land drainage increased substantially with the advent of the tile drain in 1764 and with the post-Second World War agricultural boom. The impacts of land drainage on UK river environments has been so profound that Raven *et al.* (1998: 59 and 2000: 362) have estimated that in the UK only 4.2% of river sites located below 50m have extensive floodplain wetlands on both banks. In addition to land drainage the rivers of the UK have been greatly transformed by channelisation (see Chapter 1). According to Brookes and Shields (1996a: 2), 96% of lowland river catchments in the UK have been channelised affecting urban and rural rivers alike. The construction of the railways throughout the 19th and early 20th centuries accelerated rates of channelisation (Sear *et al.*, 2000: 59), as railways were built in the lowest parts of catchments close to rivers. Alongside railway lines and stations, urban expansion proliferated further circumscribing river corridors.

Table 18. Historical background to water planning laws of England and Wales

Date	Legislation or action taken
Roman occupation	Drained land and controlled floods by means of raised banks
1258	First commission of sewers established in Lincolnshire
1600	Act of parliament passed, allowing for the recovery of many marshland. Charles I promoted the reclamation of Fens for farming
1630	Earl of Bedford agreed to drain the Fens in Cambridgeshire. By 1632, 13 other landowners joined him in this activity, forming the Bedford Level corporation
1637	Construction on Old Bedford River, caused outrage due worsening of floods
1764	Joseph Elkington (farmer) developed techniques to prevent his sheep suffering from foot rot. Intercepting underground springs, and sealing drains with stone
1861	Land Drainage Act
1920	River clearing seen as a way of relieving unemployment during great depression
1930s	New Land Drainage Act, led to 46 Catchment boards being set up
1947	Agricultural Act, led to a post-war boom in farming, as protectionism increased (except Thames and Lee catchments)
1948	River Boards Act, catchment boards became 32 river boards
1963	Water Resources Act - established 27 River Authorities
1974	River boards were incorporated into 10 Water Authorities
1976	Land Drainage Act - main rivers in England and Wales were managed solely by Water Authorities and Internal Drainage boards
1976 + discussed in Section 4.2	

Sources: Brookes, 1988; Parker and Penning-Rowsell, 1980; and Purseglove, 1989

Throughout the past two decades, 'restoration' has begun to emerge in the UK as an alternative to channelisation in parallel with an ever 'greening' environmental policy arena. The purpose of this chapter is to present the results of the first ever survey of river restoration appraisal techniques, which establishes the range of restoration projects undertaken to date and the nature of their associated appraisal procedures. This is then followed by an evaluation of the appraisal techniques and frameworks utilised on these restoration projects. Projects are first evaluated to see how far they incorporate the three components of appraisal detailed in Chapter 2, and secondly projects are evaluated against their achievement of the proposed appraisal framework delineated in Section 2.3 of Chapter 2.

This chapter commences with an overview of the policy and institutional frameworks for water resource and river management within the UK (Section 4.2). This provides the background context for the presentation and interpretation of the results of the national investigation. This section is then followed by the interpretation of the results of the national investigation of UK river restoration projects (Section 4.3) and UK river restoration appraisal procedures (Section 4.4). These two sections examine the regional location of UK river restoration projects and their associated appraisal procedures. The diversity of organisations and institutions involved in river restoration and the types of river restoration projects undertaken are examined, looking at techniques used in both river restoration projects and project appraisal. These river restoration projects are then evaluated against their achievement of the three components of appraisal detailed in Chapter 2 and their similarities to the appraisal framework proposed in Chapter 2. The constraints and driving forces which shape river restoration practice and appraisal practice in the UK are also examined considering the effects of having a diverse range of organisations involved in river restoration projects.

In Chapter 2 it was highlighted that if a project is to be successful in the long-term it needs to be developed within a structured framework of appraisal, needs to be catchment-based and should include geomorphological and public appraisal. This chapter will show that although river restoration projects are being appraised, the content of these appraisals and the techniques utilised are not always wholly conducive to the achievement of these three components of project appraisal. Also, although certain elements of the appraisal framework detailed in Chapter 2 are achieved there are many constraints which prevent such in-depth appraisal of projects. This chapter therefore argues that whilst appraisals have been quite widely undertaken by UK river restoration practitioners the techniques and frameworks employed rarely adhere to all the criteria proposed in Chapter 2.

4.2 The UK river environment: a review of policy transformations since 1948

River restoration in the UK is influenced by policies which operate across global, international, national and local spatial scales. This policy hierarchy has both national and local level implications with respect to river restoration. In recent years, environmental policy making in the UK has become focused on the achievement of the UNCED goals of sustainable development, with emphasis on biodiversity targets delineated through the UK BAP (derived from the EU Habitats Directive). However, environmental management in the UK substantially predates UNCED, and understanding the past is important in comprehending the present status of environmental management.

4.2.1 Policy transformation: 1948-1995

Throughout the 20th century a series of acts of parliament were passed in the UK that have had a strong influence on the way in which the water environment has been managed (see Table 18). The River Boards Act (1948), Water Resources Act (1963) and the subsequent Water Act (1973) led to the establishment in 1973 of ten catchment-based Regional Water Authorities. This brought together all elements of water planning, with the Regional Water Authorities overseeing the entire hydrological cycle. These post-war reorganisations occurred against the backdrop of a growing environmental movement, in parallel with Meadows *et al.* (1972) discussions of the 'Limits to growth' model and the UNCED's preliminary discussions of sustainable development.

In February 1986, a victim of the Conservative Government's privatisation policies, the multidisciplinary Regional Water Authorities were dissolved and replaced by privatised water companies with a view to improving standards, efficiency and cost-effective water allocation within the industry (DOE, 1986: 13). This transformation led to the creation of the NRA under the 1991 Water Act. The main responsibilities of the newly-formed NRA – which was split into eight catchment-based regions – included pollution control, water quality improvement, groundwater and coastal waters, flood defence and flood warning, water resource management, fisheries management, conservation of the natural water environment, promotion of water-based recreation, and the promotion of navigation in certain locations. During these reorganisations responsibilities for water supply and sewerage were handed over to the private sector with the creation of ten water supply and sewerage companies in charge of water quality, treatment and distribution (Ayton, 1994: 351). The formation of the NRA occurred simultaneously with the global expansion of environmental policy-making, and was the first time that the UK had had a body specifically devoted to the protection and management of its environment.

Prior to the formation of the NRA, environmental legislation and management had primarily been undertaken through the Wildlife and Countryside Acts (1949, 1968 and 1981). The Wildlife and Countryside Acts introduced the requirement not just for conservation of flora and fauna but also the enhancement of the environment. According to Boon (2000: 413), the changes that occurred within British conservation agencies during this period were significant as they tried to create a conservation ethic that permeated all sectors of society.

4.2.2 Policy transformation since 1995

The NRA persisted until 1995 when the Environment Act was passed. This legislation once again reconfigured environmental management in the UK, and led to the EA taking over all NRA duties (see Table 19 for EA's aims). As a public body the EA is composed of fifteen board members, including a Chairman and Chief Executive who meet six times a year. Ministers take direct responsibility for all aspects of the EA's organisation and performance, meaning that it is directly accountable through Parliament (EA, 2000b). The EA's corporate plan for 2001-2002 budgeted for the annual expenditure of £660m, which was also supported by £150m of government grants from Department of Environment, Farming and Rural Affairs (DEFRA) and the National Assembly for Wales (see Williams, 2000). Table 20 displays the EA's expenditure from 1989-2002. Water resources, environmental protection and flood defence all command the greatest expenditure per annum. This ties in with the key targets of the EA's 2001-2002 corporate plan (see Table 21) which focus on sustainable catchment-based environmental management, flood defence, and the promotion of fisheries and biodiversity. It is also consistent with the EA's principal aim of undertaking its duties through contribution towards the achievement of its sustainable development objectives (EA, 1998c: 1). A major goal of the EA is to protect key BAP sites, which were identified after UNCED's Biodiversity Convention and through the habitats directive (Raven et al., 1997: 217). Existing environmental policies do not acknowledge the roles that project appraisal, public participation or geomorphology have to play in environmental projects, though it is anticipated that these components will become enforced through the WFD.

Table 19. Aims of the EA

Principal aim of the EA: 'to protect or enhance the environment, taken as a whole, so as to make the contribution towards attaining sustainable development' (HMSO, 1995: Part 1, Chapter 1, 4 (1): 5-6).
Aims with respect to the management of water resources: • Conservation and enhancement of natural beauty and amenity of inland and coastal waters and of Land associated with such waters; • Conservation of flora and fauna which are dependent on the aquatic environment; and • Encourage use of such waters for recreational purposes (HMSO, 1995: Part 1, Chapter 1, 6 (1): 7).
Aims with regard to wildlife conservation: • Further the conservation of wildlife and landscape when carrying out water management functions (flood defence, water resource management, navigation, etc.); • Have regard for conservation when carrying out pollution control and waste regulation activities; And • Promote generally the conservation of wildlife dependent on the aquatic environment (Driver, 1997: 362).

Source: Driver, 1997; and HMSO, 1995

Table 20. Summary of EA's annual expenditure (£million)

	Actual 1989-99	Actual 1989-99	Budget 2000-01	Planned 2001-02
Fisheries	23.3	23.5	23.2	21.9
Navigation	6.9	7.8	8.5	8.2
Water Resources	86.4	85.8	95.7	97.9
Conservation	3.9	4	3.8	4.2
Collaborative projects	2	1.2	2.3	1.4
Recreation	2.1	2.3	2.1	2.1
Environmental Protection	194	204.5	218.1	220.9
Flood Defence	261.8	276.1	283.1	292.6
Sub-total	580.4	605.2	636.8	649.2
Other	12.6	12.6	13	13.2
Total expenditure	593	617.8	649.8	662.4

Source: EA, 2000b: 13

Table 21. Key targets derived from the EA's 2001-2002 corporate plan

Managing water resources

- Ensure that the existing management and future development of water resources are carried out in a sustainable manner

Integrated river basin management

- Manage surface and groundwater use to maintain water quality and balance industrial, agricultural rural and urban water uses with the needs of conservation/recreational uses of water

Flood defence

- Reduce the risk and impacts of flooding from river and the sea, by providing effective flood warnings and flood defence through delivery of our major programme of capital, maintenance and operational works

Managing freshwater fisheries

- Develop fisheries by restoring fish to rivers and lakes and improving habitats so that fish populations can prosper

Enhancing biodiversity

- Preserve and enhance the variety of animal and plant life in the UK and their habitats

Source: adapted from Williams, 2000

The EA does not have a specific remit for undertaking river restoration projects and hence does not have a specific budget set aside for such projects. This means that restoration projects survive on handouts from other functions within the EA, mitigating against proper valuations and the planning of multi-functional activities. Within the EA, money for restoration can be bid for from a variety of sources, including the flood defence budget. The EU single regeneration budget and DEFRA also provides the EA with grant-in-aid and capital funds (for flood defence projects) which can be utilised on river restoration projects. Outside of the EA, money to fund restoration projects can be gained from partnership collaborations with local authorities, the Groundwork Trust, landowners, angling groups and via Section 106 grants, heritage lottery money and the landfill tax. The demand for river restoration in the UK exceeds the EA's financial capacity to fund projects. As a result, other organisations have had to become engaged in funding and undertaking river restoration projects.

Although the EA is the main organisation presently undertaking river restoration in the UK, no one institution is legally responsible for river restoration (Briggs, 1999: 9; and Holmes, 1998b: 135). The EA undertakes its river management duties and river restoration projects in conjunction with a range of governmental bodies, NGOs and environmental consultancies. The RRC plays a central role in river restoration in the UK, and acts as a centre for the exchange of information and expertise. Also, English Nature as the government's statutory conservation body, has responsibility for the conservation of the 'best rivers', supporting their management through the production of Water Level Management Plans for all SSSI rivers and floodplain wetlands (EA, 1998a: 39). DEFRA influences the EA's management of the aquatic environment through its Water Level Management Plans (Swash, 1998: 5) and its high-level targets (SCOPAC, 2000) which encourage sustainable environmental management, the protection of BAP habitats and the development of opportunities for environmental enhancements. The Welsh region of the EA differs from the other regions in that it is an Assembly Sponsored Public Body (EA, 2002), which manages the natural environment in conjunction with the Countryside Council for Wales which combines the roles of English Nature and the Countryside Agency (EA, 1998a: 40).

In Scotland, SEPA, which was also established under the Environment Act, has responsibility for environmental management and is answerable to the Scottish Parliament. SEPA aims to protect the land, air and water in partnership with others so as to enable Scotland to sustain a strong and diverse economy (SEPA, 2002a). SEPA also has a duty to conserve water resources, involving the promotion of conservation and enhancement of natural beauty, the amenity of controlled waters and associated land, as well as the conservation of related flora and fauna (SEPA, 2002a). Holmes (1998b: 135) has reported that no major restoration schemes had yet been undertaken in Scotland.

In Northern Ireland, the River's Agency (part of DARD) has statutory responsibility (Drainage Order 1973) to reduce the risk of flooding and preserve the productive potential of agricultural land (DARD, 2002; and Oliver, 2000). With an operating expenditure of £14.5 million per annum, the Rivers Agency is responsible for the management of 6,752km of watercourses on which they construct and maintain all flood defence structures designated by the Drainage Council of Northern Ireland. The River's Agency has a duty to respect the environment and to protect fisheries, whilst also performing advisory and enforcement roles to help protect the drainage functions of watercourses (DARD, 2002). Restoration has only become an integral part of their activities since 1995 (EA, 1998a: 42; and Holmes, 1998b: 135). River restoration projects in the UK have also involved engineering companies, wildlife organisations, riparian landowners, landscape architects, hydrologists and geomorphologists (Briggs, 1999: 9).

From the above discussion it has been shown that the manner in which environmental management is undertaken in the UK is complex. This complexity is further exacerbated by the fact that the EA is sub-divided into eight regions, and Scotland and Northern Ireland possess structures of their own. The EA is composed of a head office in Bristol, eight regional offices, and three to four area offices within each region which are further divided into individual departments (see Figure 9).

Figure 9. Structure of EA (Head office, Regional offices, Area offices and Departments)

Head Office	Regional Offices	Area Offices	Departments
Bristol	Welsh	Northern South Eastern South Western	Fisheries, Biodiversity and Conservation Environment Protection Flood Defence Operations Strategic Planning Hydrometry Water Resources Development Control Authorisations Customer Contact
	Thames	North Eastern South Eastern Western	
	South Western	Cornwall Devon North Wessex South Wessex	
	Southern	Hampshire and Isle of Wight Kent Sussex	
	North Western	Central Northern Southern	
	North Eastern	Dales Northumbria Ridings	
	Midlands	Lower Severn Upper Severn Lower Trent Upper Trent	
	Anglian	Central Eastern Northern	

4.2.3 Summary: influence of policy transformations on UK river restoration practice

In this section it has been shown that environmental policy making in the UK has undergone many transformations up to the 21st century. Despite these extensive policy and structural changes the EA does not yet possess any specific funding for undertaking river restoration projects and river restoration project appraisal, and, furthermore, no statutory responsibility exists for including appraisal, geomorphology or public participation in river restoration projects. This section has also shown that no one organisation is in overall charge of river restoration in the UK. While the EA undertakes the highest proportion of river restoration projects as an organisation it is internally differentiated through its regional structure. This differentiation may give rise to a diversity of river restoration practice and appraisal practice which is related to the different needs and policies of the regions. Section 4.3 examines in greater detail the extent and nature of this diversity of river restoration practice, presenting the results of an investigation into river restoration projects across the UK.

4.3 Results of an investigation into UK river restoration practice

This section provides a broad background context to the national investigation of river restoration appraisal procedures which follows in Section 4.4. The nature of river restoration in the UK is described by drawing on the analysis of 494 project records which were contained within the RRC's river restoration database in January 2000. The data were analysed to elucidate by region where projects were being predominantly undertaken (Section 4.3.1) and what appraisals consisted of. Section 4.3.2 looks in detail at who is undertaking these projects, discussing the different organisations which have undertaken the majority of UK river restoration projects. This is then followed by a discussion of the different definitions used to describe projects by practitioners examining their understanding of the term 'restoration' (Section 4.3.3). Section 4.3.4 examines the main purpose of these river restoration projects, looking at the drivers behind river restoration projects in the UK. This section concludes by exploring the techniques used on river restoration projects, examining how they are undertaken (Section 4.3.5). Overall, the following section provides a background to the nature, quantity and regional spread of the river restoration projects which have been undertaken in the UK.

4.3.1 Project location

The spatial location of restoration projects was first explored to see if river restoration projects were being undertaken in specific locations within the UK. These patterns were examined with regards to the specific characteristics of each region (Table 22). From Table 23 it can be seen that 90% (447) of all river restoration projects on the database have been undertaken within the eight EA regions, with the Thames region dominating the practice of restoration (38%, 185 projects) and Northern Ireland undertaking the fewest projects (2%, 9 projects).

The dominance of the Thames region could be related to a range of factors. For example, in Table 22 and in Figure 10 it can be seen that the Thames region is one of the most highly impacted regions, possessing some of the most degraded rivers in the UK. The biological quality of rivers in the Thames region is shown to be quite low, thus the need for restoration may be greater than in other regions. The Thames region is also the highest spender of all regions (see Table 24), and thus may be better able to afford restoration than other regions. Additionally, 10% of this region's capital engineering budget is spent on habitat mitigation and enhancement projects on previously engineered sites (Driver, 1997: 363) due to a recognition of the damage caused by flood defence in the past (e.g. channelisation). This region also has a history of holistic river management (see Gardiner, 1991) and is the region within which the RRC is located, factors which may have influenced the higher number of restoration projects or may have led to a wider reporting of such projects than other regions due to the RRC's proximity. Interestingly, if the budget and the nature of environmental impacts of the Anglian region are viewed closely (see Figure 10, and Table 24), it can be seen that they are similar to

Table 22. Regional character, habitat features, key environmental pressures and changes needed

Region	Character	Habitat features	Key pressures/risks on the environment	Changes needed
Anglian	•Sparsely populated rural area (North East) •Extensive coast and urban centres with industry •Southern area linked to London, larger populations •Distinctive countryside	•Wetlands and broads •Lowland coastal landscape •Lowland heath, Breckland •Saltmarsh •Fens	•Agriculture => diffuse pollution, decreased water and habitat quality •Water resources •Modification/artificial management of rivers, low flows, over abstraction •Sea level rise due to climate change increasing flood risk	•Sustainable water use •Sustainable waste management •Address nitrate pollution issues restoring degraded habitats •Reclaiming habitats
Midlands	•Very urbanised and industrial in West •Intensive agriculture in lowlands •Upland farming in Peak district	•Peak district •Grassland •Ancient woodlands	•Development (for housing and roads) •Pollution/congestion from transport •Agriculture •Industry, high levels of pollution •Water supply issues •Extensive flood risk areas •Poor water quality in urban rivers, particularly high nutrient levels	•Regional planning guidance for region •Lessen pollution incidents in rivers •EC urban waste water treatment •Protection of ground water •Monitoring of contaminated land
North East	•Northern parts depend on agriculture (sheep) •Industry and intensive agriculture in Yorkshire •Diverse region •Improved water quality in last 10 years	•North York Moors •Four National Parks •AONB •Improved Salmon fisheries	•Heavy industry => poor river quality •Intensive agriculture, exceedence of pesticide standards in rivers •Much contaminated land due to mining •High levels of air pollution	•Treat contaminated/derelict land •Strategic waste management
North West	•Diverse region •Extensive farming Cumbria •Intensive farming Cheshire •Heavy industry in Manchester and Merseyside •One of most densely populated regions	•Lake District •Two other National Parks •Uplands •Coasts •Meres, Mosses	•Extensive and intensive farming •Urbanisation •Industry, leading to acid deposition •Dense population •Dereliction •Poor/bad river quality •Main storage for radioactive waste •Water supply problems	•Reduce emissions •Improve water quality •Sustainable transport •Sustainable waste management

(Table continued over leaf)

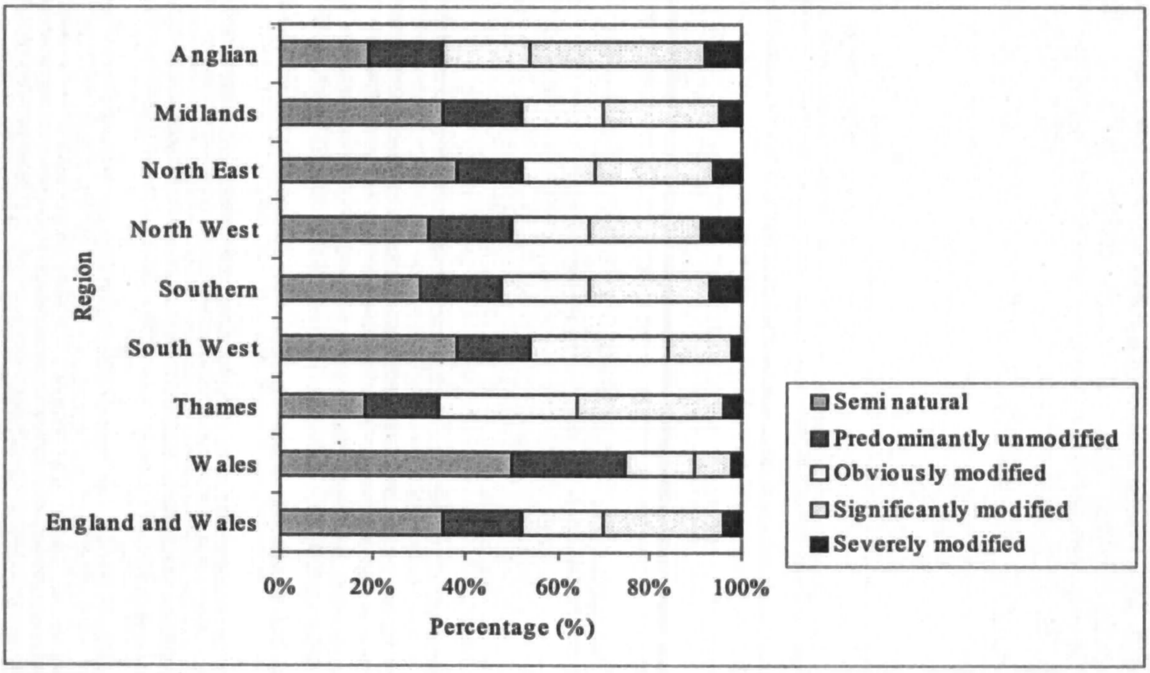
Southern	•Smallest region •Waste production and water consumption problems •Dense traffic flows, causing air pollution problems	•Lowland habitats •Chalk rivers •Ancient woodlands (New Forest) •Coasts (sand dune/salt marshes)	•Dense population, leading to high levels of development •Dense road traffic, causing air pollution •Recreation •Consumption of more water than is available •High ground level ozone •Much sewage production •High flood risks on coasts and rivers	•Sustainable management of waste
South West	•Rural, sparsely populated, intra-regional contrasts •Depends on agriculture and tourism •Best river quality in country •Soil erosion is a problem •Highest level of pollution incidents	•Extensive coastline •Dartmoor •Exmoor •1/3 under environmental designations	•Agriculture, causing soil erosion •High level of pollution incidents •High land contamination from mineworks and industry •Ground level ozone, acid and nitrate deposition •Declining Salmon populations	
Thames	•Dense population •Intensive agriculture in West •Main pressure, development •Heavy demand on water resources	•Areas of Oustanding Natural Beauty cover ¼ region •Chalk rivers •Chilterns	•Agriculture •Development for new homes and roads, decline of natural areas •High water resource demand •Poor quality/ nutrient rich rivers •Exceedence of air quality standards •Waste management problems •High flood risk	•Regeneration of brownfield sites
Wales	•Least urbanised region •Only 3% urban •High stocking densities => soil erosion problems •High quality rivers	•Snowdonia and Pembrokeshire National Parks •Heritage coast •Semi natural habitats and grassland	•High stocking densities, causing soil erosion •Much contaminated land and fly-tipping •Acidification of headwaters, leading to declining salmon stocks •Air pollution from traffic in urban areas •Flood risk from flashy rivers	•Sustainable waste management •Halting of illegal waste practices •Coastal protection from sea level rise •Address declining Salmon numbers

Sources: EA, 1998a; EA, 2000b; EA, 2000c; EA, 2000d; EA, 2001a; EA, 2001b; EA, 2001c; EA, 2001d; and EA, 2002

Table 23. Location of UK river restoration projects (sum and %)

Regions	Sum	%
Anglian	29	6
Midlands	32	6
North East	24	5
North West	56	11
Southern	46	9
South West	39	8
Thames	185	38
Wales	36	7
Scotland	38	8
Northern Ireland	9	2
Sum	494	100

Figure 10. River habitat modification in England and Wales (1994 -1997)



Source: EA, 2000b: 16

Table 24. Predicted annual expenditure per region (£million)

Region	Predicted annual expenditure 98-99
Anglian	82.5
Midlands	58.2
North East	56.7
North West	48.7
Southern	39.4
South West	45.4
Thames	90.4
Wales	49.9

Source: adapted from Williams, 2000 (no figure available for Scotland or Northern Ireland) the Thames region Yet, unlike the Thames region, the Anglian region has had significantly fewer restoration projects undertaken within it This points to the significance of Thames region's policy on environmental enhancements and its ability to divert money towards restoration

In contrast, the low percentage of restoration projects undertaken in Northern Ireland is likely to be related to the relatively recent uptake of river restoration there as the Rivers Agency is unable to undertake large restoration projects without partnerships first being established Also, flooding and poor drainage have been two major preoccupations in Northern Ireland (Sear *et al*, 2000 63-64) and hence conservation and restoration has taken a backseat.

Low incidences of restoration projects can also be found in Wales, the Southern and South West regions and Scotland For Wales and the two southern regions this is likely to be related to the fact that they all possess higher environmental and biological quality than the rest of the EA regions as seen in Figure 10 (EA, 2000b 28 and 65, and EA, 2002) The Southern region contains the greatest proportion of BAP protected chalk streams In addition, these regions' predicted annual expenditures (Table 24) are among the lowest of all the regions River restoration has also been undertaken to a lesser extent in Scotland because river quality far exceeds that of the UK Scottish rivers are considerably less damaged than the rivers of England and Wales Channelisation, river regulation and changes in land management have affected its rivers, though the history of channel modifications in Scotland is not well documented (Sear *et al*, 2000: 62) In Table 25 it can be seen that since 1996 rivers of 'fair' to 'good' quality have increased and those defined as 'poor' and 'seriously polluted' have decreased Thus perceived need for restoration is lower than more heavily impacted regions, with greater focus being placed on agricultural land management issues In comparison, in the North East, North West and the Midlands the industrial heritage still has an impact on the water quality of the rivers. This greater need for restoration often translates into a greater propensity for restoration activity

Table 25. River classification in Scotland 1996-2000

Year	Excellent (km)	Good (km)	Fair (km)	Poor (km)	Seriously Polluted (km)
1996	37743	8187	3006	1179	138
1997	37065	8553	3336	1159	142
1998	36270	8972	3742	1158	113
1999	36251	9213	3526	1171	93
2000	36477	9405	3417	873	83

Source adapted from SEPA, 2002b

In summary, it has been shown that the highest proportion of river restoration projects have been undertaken within the Thames region With the lowest incidences of river restoration being undertaken in Northern Ireland, Scotland, Wales and the Southern regions of the EA, it is inferred that these patterns are related to these regions' higher environmental quality In contrast, the Thames region possesses a more damaged environment coupled with the financial capability to finance river restoration projects

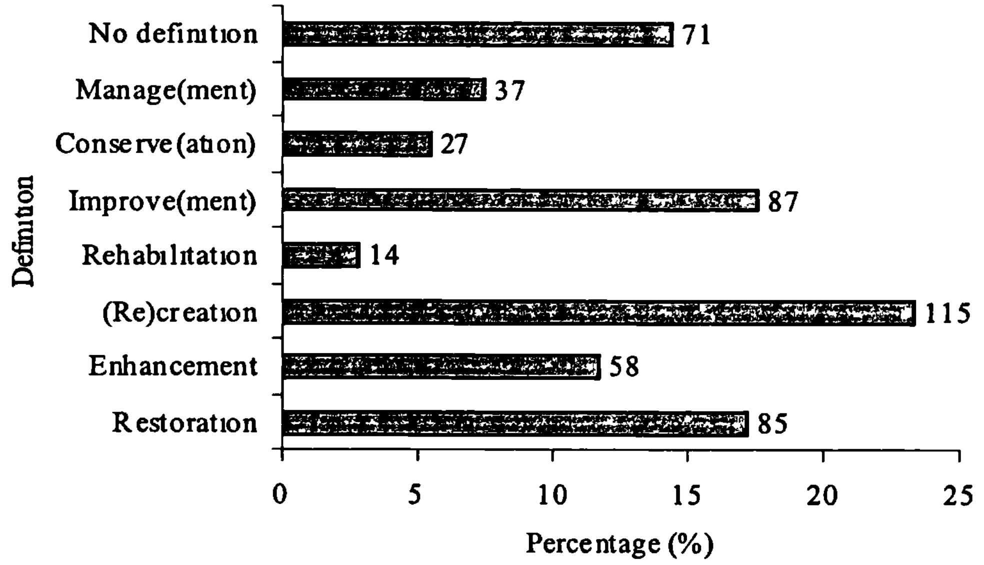
4.3.2 Organisations involved in river restoration

Many different organisations have been involved in river restoration in the UK The EA has undertaken the most river restoration projects (41%, 197 projects), and, if all statutory conservation bodies are combined, it can be seen that 43% (209) of all projects have been undertaken by these conservation bodies (EA, English Nature, Countryside Council for Wales, SEPA and the Rivers Agency) This pattern is unsurprising as the statutory bodies have legal responsibility for the environment in the UK. Environmental consultancy firms were found to have undertaken 18% of projects (85) This high percentage is likely to be related to the fact that the EA is increasingly subcontracting much of its restoration work to such firms 21% of projects were undertaken by a range of NGOs (100 projects) including groups such as the Groundwork Trust 7% of projects (32) were undertaken as part of partnerships between the EA and other agencies Partnership formation is an increasing pattern, and organisations such as the EA are benefiting from undertaking projects with matched funding and technical support from local councils and other stakeholder groups (e g River Brent enhancement project and River Kennet rehabilitation scheme)

4.3.3 Definitions used

A preliminary exploration of the RRC data examined the different terminology favoured by practitioners to describe their projects This search was driven by the fact that the literature (see Section 1 4) demonstrated that a lack of consensus existed surrounding what 'restoration' means In this research it was decided to explore whether practitioners identified with these debates and favoured alternative terms to restoration In Figure 11 it can be seen that 23% of projects (115) favoured the use of the term (re)creation, and 18% of projects (87) utilised the term improve(ment) These terms were used in preference to restoration which was employed on 17% of projects (85) This highlights the difficulties associated with these terms, and mirrors the findings of Briggs (1999 78) who discovered that UK river restoration practitioners favoured a range of alternative terms other than restoration The preference for alternatives may be due to a dislike of the term or lack of belief in restoration *per se,* reflecting the practical difficulties of undertaking projects which can be truly termed restoration

Figure 11. Definitions favoured on projects (sum and %)



4.3.4 'Main focus' of river restoration projects

All projects on the database were analysed to establish their 'main focus' (as defined in the RRC's questionnaire see Chapter 3) In Table 26 it can be seen that the main focus of 30% (149 projects) of projects was ecological improvements, with fisheries also scoring highly (15%, 75 projects) However, 25% (122 projects) did not define their main focus These patterns are consistent with a survey undertaken by Briggs (1999 77) who found that habitat and species conservation were the most common reasons for river restoration in the UK However, these national patterns conceal regional variations in the reasons for undertaking river restoration

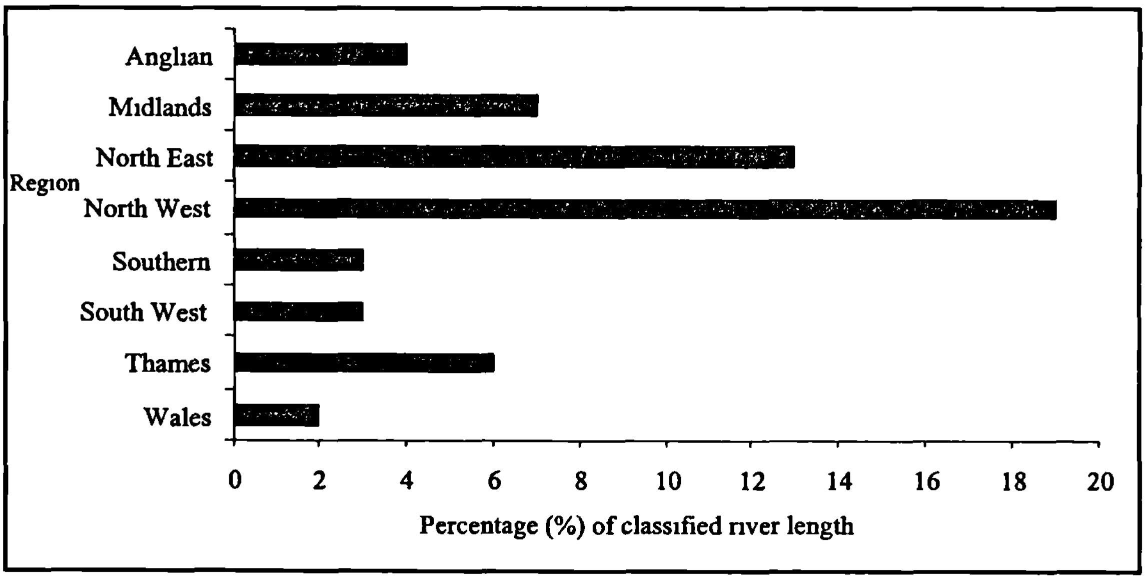
Table 26. 'Main focus' of UK river restoration projects (sum, % and average)

Main focus	Sum	%	Average
Bank Erosion	48	10	0 06
Community Demand	19	4	0 03
Development Gain	20	4	0 10
Ecological	149	30	0 25
Fisheries	75	15	0 30
Flood Defence	32	6	0 15
Landscaping	12	2	0 04
Pollution Mitigation	17	3	0 02
None Defined	122	25	0 04
Sum Total	494	100	

In the Anglian region restoration projects were found to be mainly ecologically focused (38%, 11 projects), a pattern backed up by the EA (1998a 23) who found that in this region an emphasis was placed on the restoration of both habitat and habitat structure This need to restore riverine habitats may be related to the region's long history of channelisation which has led to 2000 km of river being straightened and 33% channelised (RRP, 1993 14), and also due to the impacts of agricultural pollution on habitat (EA, 2000b 63) In this region flood defence has also been a prominent driver behind restoration (21%, 6 projects) related to the low-lying nature of this catchment which makes it prone to flooding

In the North East region, although projects have tended to focus on fisheries, the EA (1998a 7) has found no clear indication of restoration priorities In the Midlands and North West regions ecological restoration has been the main focus This pattern is unsurprising given the North West region has the worst biological quality of all the EA regions and river quality was classed as poor/bad due to the impacts of the region's past industrial heritage and rapid urbanisation (see Figure 12, EA, 2000b 64) The rivers of the Midlands have also been classed as poor/bad in relation to aesthetics and industrial pollution (EA, 2000b, and EA, 2002). Having said this, the North West has made a move towards conserving the region's best rivers (EA, 1998a 11), and in the Midlands a significant number of urban restoration projects have been undertaken (EA, 1998a. 15) In both the Midlands and the North West, flood defence was the second most common reason for undertaking restoration works (Midlands, 13%, 4 projects, and North West, 9%, 5 projects) This is possibly related to both regions' dense populations and intensive agricultural traditions which have led to encroachment upon floodplains

Figure 12. Rivers of poor or bad biological quality in England and Wales (1995)



Source EA, 2000b 20

In the least modified regions – Southern, South West and Wales – the prime focus of restoration projects has also been ecological In the Southern region, a strong emphasis on the management of chalk streams over restoration has been witnessed (EA, 1998a 31) with restoration projects tending to be undertaken as a result of conservation work One third of the South West region is under environmental designations, hence restoration projects have been mainly focused on ecological or fisheries restoration Restoration is seen as secondary to conservation in this region (EA, 1998a: 35), and this is possibly related to the high number of statutory environmental designation and the higher quality of the region's rivers Both the South

West and Wales undertook many restoration projects for fisheries purposes (South West, 11%, 20 projects, and Wales 17%, 6 projects). These patterns are related to the fact that the EA has sought to restore reaches of the Chalk streams of Hampshire and Dorset for fisheries benefits by using improvements to channel morphology to encourage a more natural stream ecology (Frake, 2000) In the South West, bank erosion was the second most frequently cited focus of restoration projects This could be related to the region's focus on fisheries and hence the need for shady banks for fish spawning In Wales a similar preference towards conservation over restoration was also evident (EA, 1998a 19)

The Thames region has also undertaken a proportion of its projects with a main focus on ecology (35%, 64 projects) and fisheries (11%, 20 projects). This is likely to be related to the fact that since 1997 this region has spent 5% (£500-800k per annum over six years) of its flood defence revenue budget on the implementation of habitat enhancement projects associated with on-going or past works, or as a result of flood defence projects (Driver, 1997 362-363, and EA, 1998a 27) Bank erosion projects have also been prevalent in this region (7%, 13 projects), with channel and bank erosion projects being undertaken for conservation purposes (EA, 1998a 27). 7% of projects (13) have been undertaken for development gain (e g business parks, new housing estates, and construction of new roads) The Thames region is the most densely populated and urbanised region of the UK with the highest number of properties located on floodplains (627,000) (EA, 2002)) With development highlighted as one of the Thames region's main environmental pressures (see Table 22), it is thus unsurprising that a number of projects have been undertaken as a result of development plans (e g as developers attempt to mitigate their construction activity) A large proportion of projects have also been funded from the region's flood defence budget, with some restoration projects being undertaken in conjunction with flood alleviation works

In Scotland restoration has been focused on fisheries (34%, 13 projects). This may be due to commercial salmon farming and the popularity of fishing in this region (Sear *et al*, 2000 62). For example, the Tweed Foundation's main aim is to restore the River Tweed (Scotland/Northumberland border) for the development of Salmon and Trout stocks This is achieved through the encouragement of more sustainable land management practices (e g removal of grazing from river's edge) and the introduction of in-stream structures to restore physical habitat to benefit these species. In Northern Ireland, improvement of fisheries has also been a main driver of restoration projects (56%, 5 projects) However, an urban rehabilitation project has been recently completed on the Derriaghy river in Belfast (Jamieson, 2002. 5). Both regions placed a secondary focus on ecology (Scotland 16%, 6 projects and Northern Ireland 11%, 1 project)

This section has shown that river restoration practice in the UK is diverse, and that this diversity of practice can be related to the specific catchment geography of each region Each region is differentiated in terms of their environmental quality and therefore the need for restoration Regionally, there also exists different pressures on the environment (e g fishing, leisure, industry and development) and these factors influence both the need for and the nature of the river restoration project undertaken. Between regions different human pressures are exerted upon catchments and their associated rivers and the need for restoration hence differs depending upon the environmental quality of the individual region and the different desired outcomes of river restoration projects

4.3.5 River restoration techniques

The RRC data allows analysis of the different types of restoration techniques employed on all UK river restoration projects First of all the restoration techniques were subdivided into six categories· geomorphology, ecology, pollution, agricultural, public and other (further details of these six categories are found in Chapter 3) The number of techniques employed in each of these six categories was first analysed, and then each category's sub-categories were further examined in order to yield greater detail on the specific restoration techniques employed

It was found that 63% (311) of the projects were undertaken using ecological restoration techniques Geomorphological techniques were also prevalent, and were employed on 50% (245) of all the projects 6% (31) of all the projects undertook agricultural techniques 9% (45) of all the projects undertook pollution mitigation work, and 21% (102) of all the projects involved the public (see Table 27 for a regional breakdown of restoration techniques) These patterns are in line with the previous section which looked at the main focus of river restoration projects, except in this instance a prevalence for public consultation was discovered

Geomorphological restoration techniques Geomorphological and ecological techniques were the most commonly employed in all regions except in Scotland where public techniques were second to ecological techniques (Table 27) The prevalence of geomorphological techniques was not predicted given that few geomorphologists are employed nationally in the organisations responsible for river restoration This high prevalence of geomorphological restoration techniques may possibly be related to practitioner(s) loose understanding of what geomorphology comprises For example, they may perceive the construction of a riffle as geomorphology, when a geomorphologist would not consider this alone as geomorphological restoration The same patterns were therefore evident not only nationally but also regionally For the calculation of regional patterns percentages could not be utilised as in some instances more than one type of technique was used per project, thus sums per region often exceed the actual number of projects undertaken.

The prevalence of geomorphological restoration techniques in this analysis may also be related to the fact that ecological restoration is tightly coupled with the recreation of a river's geomorphological structure (e g channel geometry) to help in the creation of functional habitats This prevalence of the restoration of morphological structure fits well with the results of Briggs (1999 79) who found that planform change and bedform change were the most

Table 27. Summary of restoration techniques (sum) employed on UK river restoration projects

	Anglian	Midlands	North East	North West	Southern	South West	Thames	Wales	Scotland	Northern Ireland	Sum (%)
a) Geomorphology											
•Flood alleviation- mitigation- control- defence	2	3	1	4	2	5	18	2	2	1	40 (8)
•Channel maintenance work (e g partial dredging)	2	2	0	0	2	0	9	0	0	1	16 (3)
•Reinstatement of channel geometry, riffle-pool sequence	2	5	2	1	8	7	14	2	0	1	42 (9)
•River diversion (weirs, deflectors, boulders, debris, gabions)	3	5	1	4	2	5	17	4	3	2	64 (13)
•Resizing of channel (narrowing, widening)	0	1	0	4	2	3	25	0	0	0	35 (7)
•Sediment introduction (instream structures)	0	0	1	1	2	0	16	1	0	0	21 (4)
•Flood storage (water control structures)	2	2	0	2	0	1	2	0	1	1	11 (2)
•Flow alteration	1	3	0	0	2	0	14	0	0	0	20 (4)
•Reduce erosion	0	3	4	1	3	3	5	1	4	0	24 (5)
•Removal or modification of impoundments	0	0	1	2	2	0	8	0	0	0	13 (3)
•Restore connectivity between river and floodplain	3	0	0	1	0	1	5	2	0	0	12 (2)
•Replace concrete channel with natural channel	0	0	1	3	4	1	12	1	0	0	22 (4)
•Restore in-channel geomorphic diversity	1	1	0	0	2	1	6	0	0	0	11 (2)
•Reprofiling	4	0	0	3	5	1	13	3	0	0	29 (6)
•Meander recreation (restoration of sinuosity or bends)	2	4	0	2	3	3	5	1	0	1	21 (4)
•Restore water levels	1	0	0	0	0	0	1	2	0	0	4 (1)
•Bioengineering using geotextiles	1	0	0	0	1	0	11	2	0	0	15 (3)
•Backwater creation	0	1	0	0	1	0	7	0	0	0	9 (2)
•Fencing	0	1	2	4	2	1	0	0	0	0	10 (2)
Sum	24	31	13	32	43	32	188	21	10	17	
b) Ecological											
•Provide cover for fish and aquatic organisms	1	2	0	0	4	3	8	3	3	0	24 (5)
• Introduce fish ladders or passes, removal of obstructions	0	0	1	1	0	0	8	1	4	1	16 (3)
•Enhance fish stocks and aquatic habitats	4	2	8	6	11	7	20	2	13	2	75 (15)
•Restore riparian zone for habitat enhancement- river corridor creation	0	1	0	2	4	3	2	0	6	0	18 (4)
•Bank stabilisation and protection with plants	2	0	2	2	8	2	23	6	1	1	47 (10)
•Wetland-wet meadow- water meadow creation or restoration	4	11	2	2	3	5	17	4	0	0	48 (10)
•Restore plant habitat diversity	2	6	3	6	3	0	19	3	5	0	47 (10)
•SSSI protection	0	0	0	1	0	0	2	1	0	0	4 (1)
•Recreate various mammal-wildlife habitats	2	1	5	0	1	3	5	1	0	0	18 (4)
•Reed bed planting- also willow and alder	3	3	1	2	0	1	7	4	0	0	21 (4)
•Restore general habitat diversity (floral and faunal)- biological diversity	12	9	9	12	10	8	33	3	5	2	103 (21)
•Creation of bird habitats	1	1	2	0	0	1	5	2	0	0	12 (2)
•Protect existing heritage	2	0	0	1	0	0	0	0	0	1	4 (1)
•Hedgerow restoration	0	0	0	0	1	0	0	0	0	2	1 (0)
•Restore woodland or forest- tree planting	2	0	2	1	2	2	4	1	2	2	16 (3)
•Pond-lake-scrape-ditch-fen-island creation or restoration	1	2	0	4	5	1	19	4	0	0	36 (7)
Sum	36	38	35	40	52	36	172	35	39	7	

Table continued over leaf

c) Pollution mitigation											
•Improve water quality	0	1	5	7	0	4	5	0	3	1	26 (5)
•Pollution mitigation, use of natural buffers	0	0	2	1	0	2	4	1	1	0	11 (2)
•Clean-up contaminated land	0	1	0	0	0	0	5	0	0	0	6 (1)
•Removal of litter	0	0	0	1	1	0	1	0	0	0	3 (1)
•Channel dredging, remove dumped objects	0	0	0	0	0	0	1	0	0	0	1 (0)
•Reduce chemical run-off from agricultural, farm waste management	0	0	1	1	0	0	1	0	2	0	5 (1)
Sum	0	2	8	10	1	6	17	1	6	1	
d) Agriculture											
•Buffer zone creation	0	1	1	0	2	1	2	0	2	0	9 (2)
•Conversion of farmland to ameliorate habitat potential, environmentally sensitive farming	2	0	1	0	2	0	2	0	1	0	8 (2)
•Grants aid-advice	0	1	1	0	1	1	0	0	3	0	7 (1)
•Improve-create cattle crossings	0	0	0	0	1	0	0	0	0	0	1 (0)
•Reduce grazing or access by cattle	0	1	1	2	2	1	0	0	2	0	9 (2)
•Increase grazing	0	0	0	0	0	0	0	0	0	1	1 (0)
Sum	2	3	4	2	8	3	4	0	9	0	
e) Public											
•Enhancement for recreation and amenity purposes (community benefit)	5	5	3	7	5	4	14	2	3	1	49 (10)
•Increase public awareness	4	0	0	6	0	0	3	0	4	0	17 (3)
•Create and educational resource	0	3	2	3	1	5	7	1	8	1	31 (6)
•Path-widening- stabilisation for pedestrians, footbridges, benches, towpaths	2	0	1	3	4	1	9	0	1	0	21 (4)
•Improve public access	2	1	1	4	2	1	7	0	5	1	24 (5)
•Creation of platforms for anglers	0	0	0	0	0	0	0	0	0	0	0 (0)
•Creation of mooring area for boats	1	0	0	0	0	0	2	0	0	0	3 (1)
•Working with local people- community based	1	1	3	4	6	3	3	0	6	0	27 (5)
Sum	15	10	10	27	18	14	45	3	27	3	
f) Other											
•Increase river's economic value for local community- local businesses- agriculture-tourism	1	1	1	2	2	1	0	0	2	0	10 (2)
•Landscape amelioration	0	1	2	1	1	1	0	1	1	0	8 (2)
•Creation of a sustainable river system, sympathetic river management	1	2	1	9	2	2	30	0	2	2	51 (10)
•Monitoring-appraisal	1	3	0	1	2	1	6	1	1	1	17 (5)
•Project at proposal stage	1	0	1	1	0	0	2	0	0	0	5 (1)
Sum	4	10	6	14	8	5	44	3	10	3	

commonly employed geomorphological restoration techniques Within this geomorphological category, restoration to alleviate flooding, reinstate channel geometry or to undertake river diversions were the most prevalent techniques, employed on 40-64 projects (8-13%)

Geomorphological restoration is beginning to be recognised as a means of facilitating flood alleviation, as the restoration of a river's geomorphological connectivity with its floodplain can help create a flood storage reservoir for downstream reaches The reinstatement of channel geometry as a form of geomorphological restoration is also coupled with the above-mentioned creation of functional habitats River diversions often do not start off as restoration projects as they are usually undertaken to make room for new housing developments, to allow new roads to be constructed, or are undertaken to reduce flood risk to properties However, geomorphological restoration can be undertaken as a result of them, as they may attempt to use past geomorphological templates to create more 'natural' looking channels (for example, River Colne diversion, Stanwell Moor) There was also a prevalence of flood defence projects, related to the fact that the EA has been increasingly undertaking rehabilitation projects as a result of flood defence works The Thames, Southern, Midlands and North West regions have utilised the greatest variety of such techniques (see Table 27a) No clear regional patterns of preferred geomorphological restoration techniques were evident

Ecological restoration techniques The high percentage of projects using ecologically-focused restoration techniques is likely to be related to the fact that a large proportion of projects were driven by ecological or fisheries incentives (see Table 27b) Restoration of general habitat diversity (floral and faunal diversity) is employed on the greatest number of projects (21%, 103 projects) The greatest variety of ecological restoration techniques have been employed in the Thames, North West and Southern regions This pattern is a likely result of the UK BAP which requires the protection of certain species to help preserve biological diversity within the UK The enhancement of fish stocks also featured strongly (15%, 75 projects) because fisheries was the second most cited reason for undertaking restoration projects The Southern region, Scotland and Northern Ireland prioritised the usage of fish stock/habitat enhancement techniques (the strong fisheries interests of Northern Ireland have been highlighted by Sear *et al*, 2000 63) The Welsh region favoured bank stabilisation techniques, and the Midlands region prioritised the creation of wetlands, with the remaining regions focusing on the recreation of habitat diversity

Pollution and agricultural restoration techniques Pollution mitigation projects and agricultural projects were less prevalent than geomorphological (see Table 27c-d), ecological and public techniques, and tended to revolve around the reduction of impacts on riverine systems Regarding pollution mitigation, 5% (26 projects) aimed to improve water quality This is consistent with agricultural projects whereby 2% (9 projects) aimed to create buffer zones to reduce nitrate pollution in water (the West Country Rivers Trust created 32 buffer zones as part of a catchment management programme) The Thames and North East regions and Scotland have undertaken the greatest number of pollution mitigation projects to help improve water quality and to use natural buffers to achieve these water quality improvements by reducing agricultural runoff (see Table 27c) The North East and Scotland are particularly agricultural regions which helps explain this pattern, and the Thames region is highly agricultural in its western and north east areas With regards to agricultural techniques, Scotland and the Southern region utilised the greatest range of these techniques Both regions placed an emphasis on more sensitive farming techniques (e g buffer zone creation) and reducing the access of cattle to rivers These patterns reflect a drive towards the implementation of more sustainable land management techniques

Public restoration techniques Restoration techniques which improve river corridors for the benefit of the public were also evident (see Table 27e) This pattern is not consistent with the analysis of restoration projects' 'main focus' which did not identify community demand as a prominent reason for restoration (except in the North West region of the EA where it featured on 16% of projects) The reason for this inconsistency may be related to the wider array of sub-categories utilised in the analysis of restoration techniques However, the prevalence of 'public' projects may be related to the fact that the importance of public inclusion in environmental decision making has been highlighted in Agenda 21 which has been implemented in the UK through Local Agenda 21. Additionally, increasing numbers of projects undertaken in urban locations have been engaging the local public in decision making (especially in partnership projects) In this category of public projects, 10% (49) of projects undertook restoration work to improve amenity and recreational opportunities for the public and 6% (31 projects) aimed to create an educational resource for the local community The greatest number of public restoration techniques have been employed by the Thames and North West regions and also in Scotland The first two regions have had a high proportion of urban restoration projects (31% and 41%) which are frequently undertaken for recreational or educational reasons, and the Thames region has a history of public consultation and appraisal In Scotland many projects have been undertaken in conjunction with farmers to help promote more sustainable land management practices For example, SEPA's Habitat Enhancement Initiative also encourages communities to adopt watercourses and facilitate their enhancement (SEPA, 2002c, and Walker, 2000. 3)

Other restoration techniques 21% (116) of projects fell under the category 'other' (see Table 27f) Within this category 10% (51) of projects were undertaking restoration work to create a more sustainable river system or to encourage more sympathetic river management Landscaping was undertaken on 2% (8) of projects With regard to appraisal and monitoring, 5% (17) of projects made reference to either or both of these terms, with the Thames region mentioning them the most frequently (on 2 projects)

4.3.6 Summary: general patterns of UK river restoration projects

This section has provided an overview of the nature of river restoration in the UK and has shown that the majority of UK river restoration projects are

- Undertaken by the Thames region of the EA (38%) with the fewest restoration projects having been undertaken in Northern Ireland (2%),
- Undertaken to a greater extent in the most degraded regions (Anglia, Midlands, Thames, North East and North West),
- Undertaken primarily by the EA (41%) and by consultancy firms (18%) although it was seen that a wide range of different organisations undertake river restoration projects,
- Primarily focused on ecology (30%) and fisheries (15%) though it was seen that projects were also focused on many other aspects of river restoration, and
- Undertaken using a wide range of ecological restoration techniques (63%) and geomorphological restoration techniques (50%)

In summary, a diverse range of restoration projects have been undertaken across the UK by a range of different organisations using a variety of different restoration techniques The patterns described accord with Everard's (1998 478) belief that the character of the restoration projects undertaken within each region of the UK is influenced by the individual region's physical and political structures For example, the Thames region with its history of holistic appraisal and geomorphological appraisal, has been the most frequent employer of geomorphological techniques and has made the most reference to appraisal in the literature However, it can also be seen that the nature of river restoration is influenced by national environmental policies, as it is anticipated that implementation of the UK BAP has been the main driver behind the strong ecological focus of most of the restoration projects The EA has undertaken the most restoration projects nationally and its regional structure has led to a diversity of river restoration practice between regions which has been discussed above

Although a low incidence of appraisal was evident from this analysis of the RRC's database, the manager of the RRC was aware that project appraisals had been undertaken in all ten regions The RRC data were thus able to provide a background description of river restoration at the national scale but they did not yield sufficient information on project appraisal, the focus of this thesis Due to this lack of information on project appraisal, a national investigation of river restoration project appraisal was undertaken The following section discusses the results of this investigation and evaluates the appraisal techniques utilised by river restoration practitioners in the UK.

4.4 The appraisal of UK river restoration projects: a national survey

This section describes the nature of river restoration appraisal in the UK drawing on the results of a national investigation of river restoration appraisal procedures This was undertaken by means of a questionnaire survey (described in detail in Chapter 3) The questionnaire was sent to a total of 161 people involved in 492 restoration projects From this survey an 80% response rate was achieved. These data were analysed and interpreted in the following sections to evaluate the

- Regional location of questionnaire responses compared to regional location of appraised projects (Section 4 4 1),
- Extent of project appraisal (Section 4 4 1),
- Appraisal techniques employed (Section 4 4 2), and
- Constraints to project appraisal (Section 4 4 3)

This analysis is undertaken at the national and regional levels, and is combined with available literature and the results of Section 4 3 The data presented in this section is further discussed and interpreted in Section 4 5.

4.4.1 Location and extent of appraised projects

Regional location of questionnaire responses Prior to analysing the data for the 286 projects, the data were first of all ordered to help ascertain whether the same regional patterns found in Section 4 3 were evident In Table 28 it can also be seen that the majority of projects were undertaken in the Thames region and the least in Northern Ireland (consistent with the data analysis in Section 4 3)

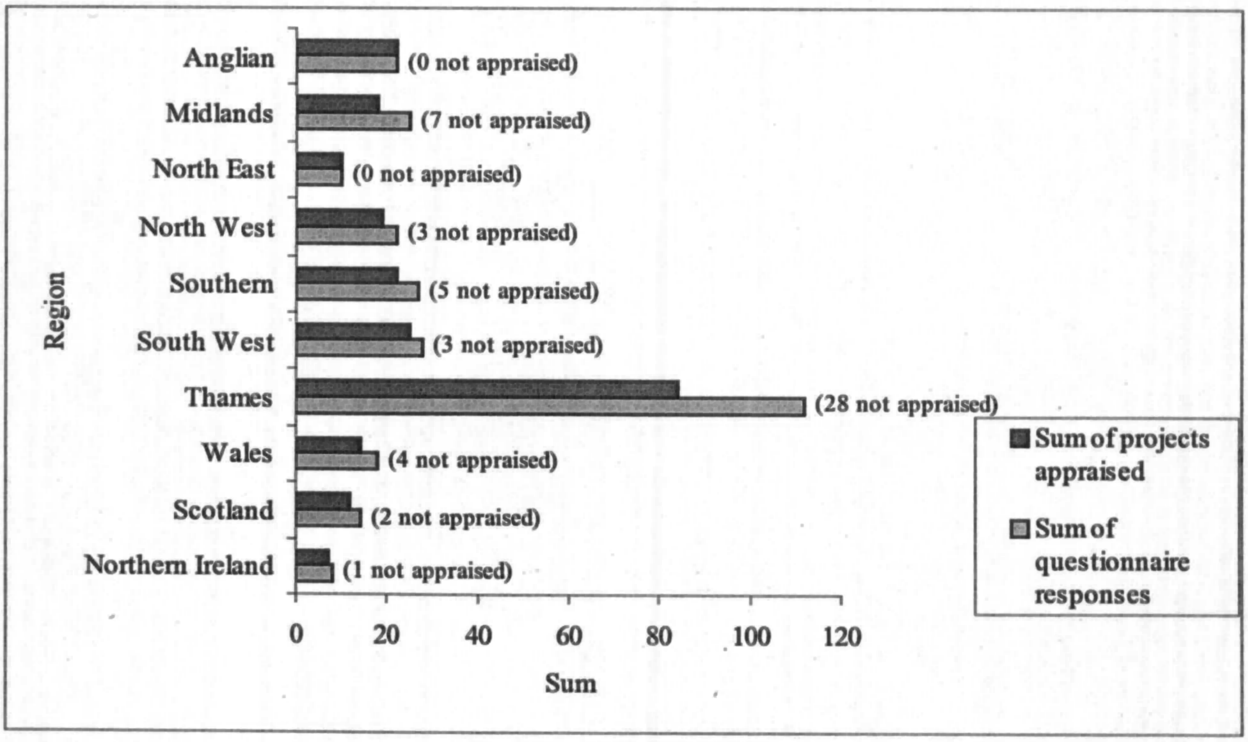
Table 28. Regional summary of percentage (sum) of questionnaire responses, numbers of projects appraised and numbers of projects not appraised

	Questionnaire responses	Projects appraised
Anglian	8 (22)	9 (22)
Midlands	9 (25)	8 (18)
North East	3 (10)	4 (10)
North West	8 (22)	8 (19)
Southern	9 (27)	9 (22)
South West	10 (28)	11 (25)
Thames	39 (112)	36 (84)
Scotland	5 (14)	6 (14)
Wales	6 (18)	5 (12)
Northern Ireland	3 (8)	3 (7)
Total	100 (286)	100 (233)

Were projects appraised? The first question on the questionnaire asked respondents whether appraisal had been undertaken. Out of these 286 projects 74% (211) stated that appraisal had been undertaken, and 26% (75) replied that no appraisal had been undertaken. These data were explored in greater detail and it was found that 22 out of the 75 projects which responded negatively had in fact been subject to an appraisal as the respondent had filled out appraisal boxes in the questionnaire. Thus, a recalculation of these data found that 81% (233) of projects had been appraised and 19% (53) had not. This high percentage of project appraisal was surprising given that analysis of the RRC database had shown that only 5% of restoration projects made reference to appraisal. However, this pattern indicated a misunderstanding of what appraisal means on the part of some of the respondents.

Regional location of appraised projects. Figure 13 shows the number of appraised projects per region, and also details the numbers of projects per region which have not been appraised. The Thames region undertook the greatest number of project appraisals, possibly due to this region's history of holistic appraisal and the greatest number of river restoration projects having been undertaken in this region. However, there are no significant differences between the regions in whether appraisal was undertaken or not.

Figure 13. Regional summary of appraised projects



Appraised projects extent of appraisal The questionnaire survey asked respondents to define the extent of appraisal· whether it was undertaken at the pre-project stage, during the project, at the post-project stage, or during all of these stages 71% (166) of projects undertook pre-project appraisals only, 37% (87) during the project, and 66% (154) at the post-project stage (see Table 29) No specific patterns were evident here, although it is interesting to note that a greater number of projects undertook pre-project appraisals than post-project appraisals, perhaps highlighting the difficulties in finding adequate resources (financial and temporal) for undertaking post-project appraisals In total 21% (61) of appraised projects undertook appraisal at all stages of the project (pre-project, during and at the post-project stage) As discussed in Chapter 2, in order to fully appraise a project's success appraisal needs to be undertaken continually throughout the project's duration Less than a quarter of the restoration projects covered by this survey undertook appraisal throughout It will therefore be difficult for practitioners to fully appraise whether their projects achieved what they initially set out to achieve

Table 29. Percentage (sum) of the different stages of project appraisal across each region

	Pre-project	During	Post-project	All
Anglian	82 (18)	23 (5)	64 (14)	5
Midlands	56 (10)	28 (5)	78 (14)	5
North East	50 (5)	40 (4)	50 (5)	1
North West	95 (18)	53 (10)	58 (11)	6
Southern	68 (15)	50 (11)	82 (18)	7
South West	80 (20)	32 (8)	60 (15)	6
Thames	68 (58)	39 (33)	65 (55)	26
Wales	71 (10)	36 (5)	86 (12)	3
Scotland	75 (9)	42 (5)	33 (4)	2
Northern Ireland	43 (3)	14 (1)	86 (6)	0
% (sum)	71 (166)	37 (87)	66 (154)	61

4.4.2 Appraisal techniques employed in river restoration projects

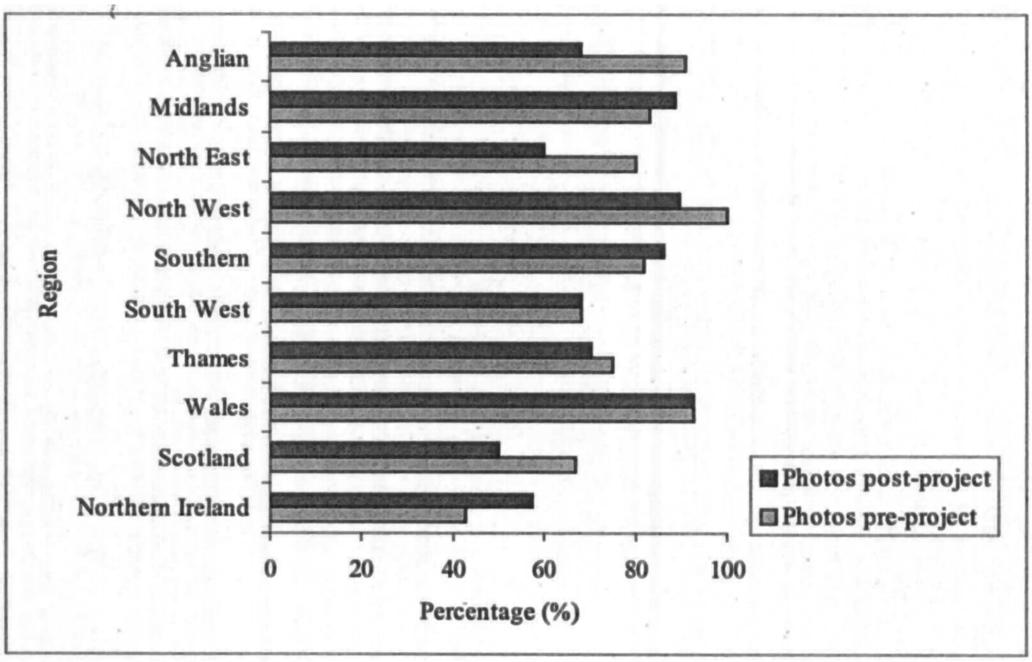
The range of appraisal techniques utilised on the 233 projects which were appraised is now explored in order to ascertain the nature and range of techniques utilised and their regional locations Appendices D-I provide regional summaries for each technique It can be seen overall that pre- (79%, 184) and post-project photographs (74%, 172) were the two most commonly employed appraisal techniques, followed by site visits to subjectively view a completed project or take photos (48%, 111), fisheries surveys (35%, 82), environmental assessments (30%, 71), landscape assessments (30%, 69) and channel cross-section measurements (29%, 67) These different appraisal techniques (see Table 30) are now explored in greater detail considering regional patterns which may be exhibited due to the different regional environmental characteristics discussed in Section 4 3

Table 30. Percentage (sum) of all appraisal techniques employed

Appraisal technique		% (sum)
Visual	Photos pre-project	79 (184)
	Photos post-project	74 (172)
	Aerial photos	2 4 (2)
	Video	1 (2)
Geomorphological	Channel cross-section measurement	29 (67)
	Delineation of reference reach	8 (19)
	Geomorphological modelling	27 (62)
	Fluvial audit	12 (27)
Ecological	Habscore	3 (7)
	RCS	24 (56)
	RHS	13 (31)
	RIVPACS	10 (24)
	Fisheries survey	35 (82)
	PHABSIM	3 (7)
	SERCON	1 (2)
	Invertebrate- macroinvertebrate survey	6 (14)
	Faunal surveys	3 (6)
	Botanical surveys	10 (24)
Public	Discussion groups	21 (48)
	Public enquiry	6 (13)
	Questionnaire survey	8 (18)
Pollution	Monitoring of contaminated land	5 (10)
	Water quality monitoring	17 (35)
'Other'	Cost Benefit Analysis	18 (43)
	Environmental assessment	30 (71)
	Landscape assessment	30 (69)
	Return monitoring	18 (43)
	Site visit	48 (111)
	RRC audit	9 (22)
	Appraised through academic research	3 (7)
	Use of historical records	1 (2)

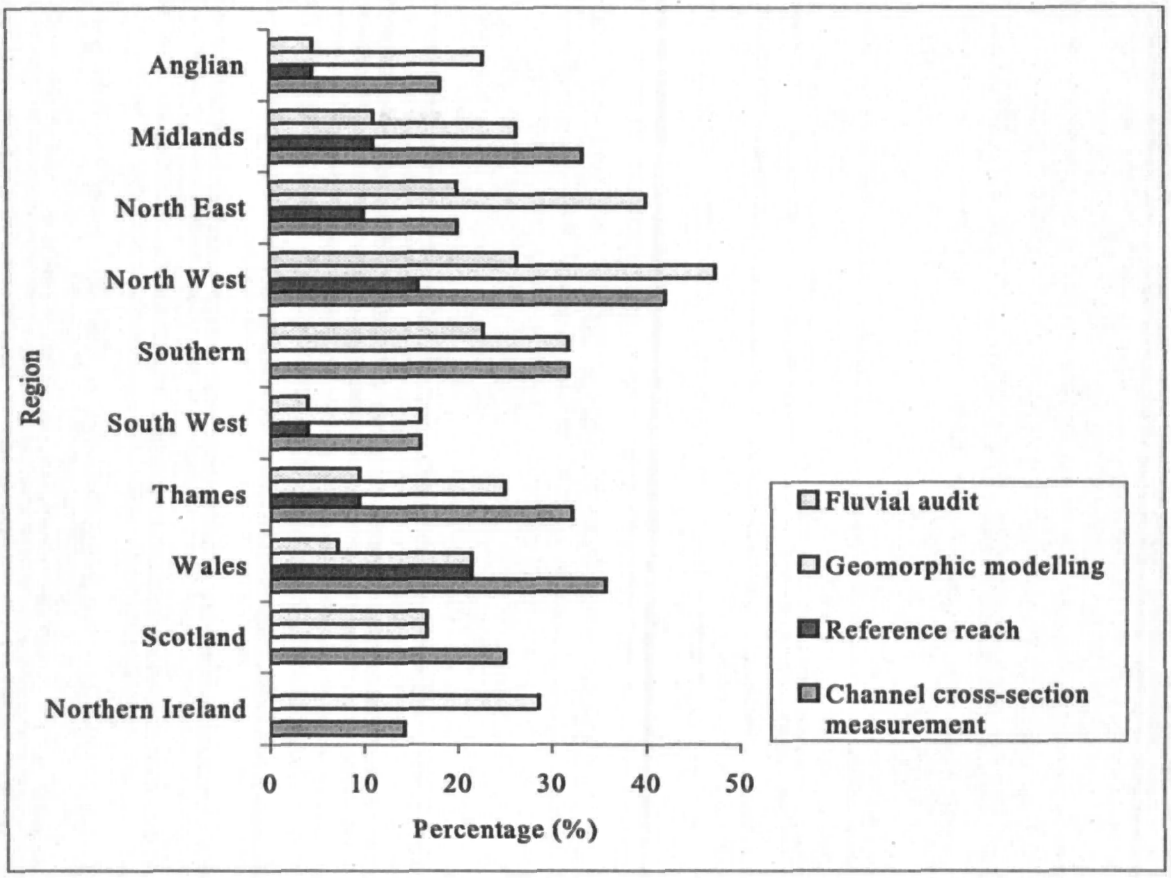
Visual appraisal techniques In Figure 14 and Appendix D it can be seen that all regions favoured the usage of pre- and post-project photographs as a form of visual appraisal Pre-project photographs were undertaken on more projects than post-project photographs (79% rather than 74% of all appraised projects in the UK) despite the fact that both are required to effectively appraise a project There were no specific regional patterns with regards to photographs as it was employed as one of the main appraisal techniques in all regions and was employed on all 19 appraised projects in North West region Other visual appraisal techniques have included video footage (Afon Ogwen project, Wales, and Sugar Brook project, North West region) and aerial photography The prevalence of photography emphasises the fact that both time and money are often the biggest constraints for those undertaking restoration work Photography provides a quick, easy and cheap form of appraisal However, if the photographs taken are not later evaluated through subjective comparison against a photograph of the pre-project conditions at the site then they cannot be seen as appraisal techniques The fact that photography is the commonest form of appraisal suggests that more extensive frameworks of appraisal such as is described in Chapter 2 are not commonly employed

Figure 14. Percentage regional summary of visual appraisal procedures



Geomorphological appraisal techniques. In Figure 15 and Appendix E it can be seen that 29% (67) of all appraised projects undertook channel cross-section measurements, 27% (62) geomorphological modelling, 12% (27) fluvial audits and 8% (19) delineated reference reaches. If all four techniques are summed then the Thames region has undertaken the most geomorphological project appraisals (64), followed by the North West region (25), and then the Southern region (19). Northern Ireland (3) and Scotland (7) have utilised geomorphological appraisal techniques the least of all regions. The Thames region is the only region which has a geomorphologist employed within the EA, also within London 41% of main river is channelised hence there is a distinct need for geomorphological restoration of river channels. According to Douglas (1988: 63), in the North West planning procedures recognise geomorphological features as needing protection. Channel cross-section measurements were the most favoured geomorphological technique, they may be undertaken to physically reconstruct a channel's past geomorphological structure, increasing habitat diversity and restoring features such as pools and riffles which may have been previously lost. In Figure 15 it can be seen that Northern Ireland is the only region which has not undertaken fluvial audits, and the Southern region, Scotland and Northern Ireland have not utilised reference reaches as a proxy during restoration. These patterns point towards the uneven incorporation of the principles of geomorphology into river restoration projects. The importance of the role of geomorphology in river restoration and river restoration project appraisal was highlighted in Chapter 2.

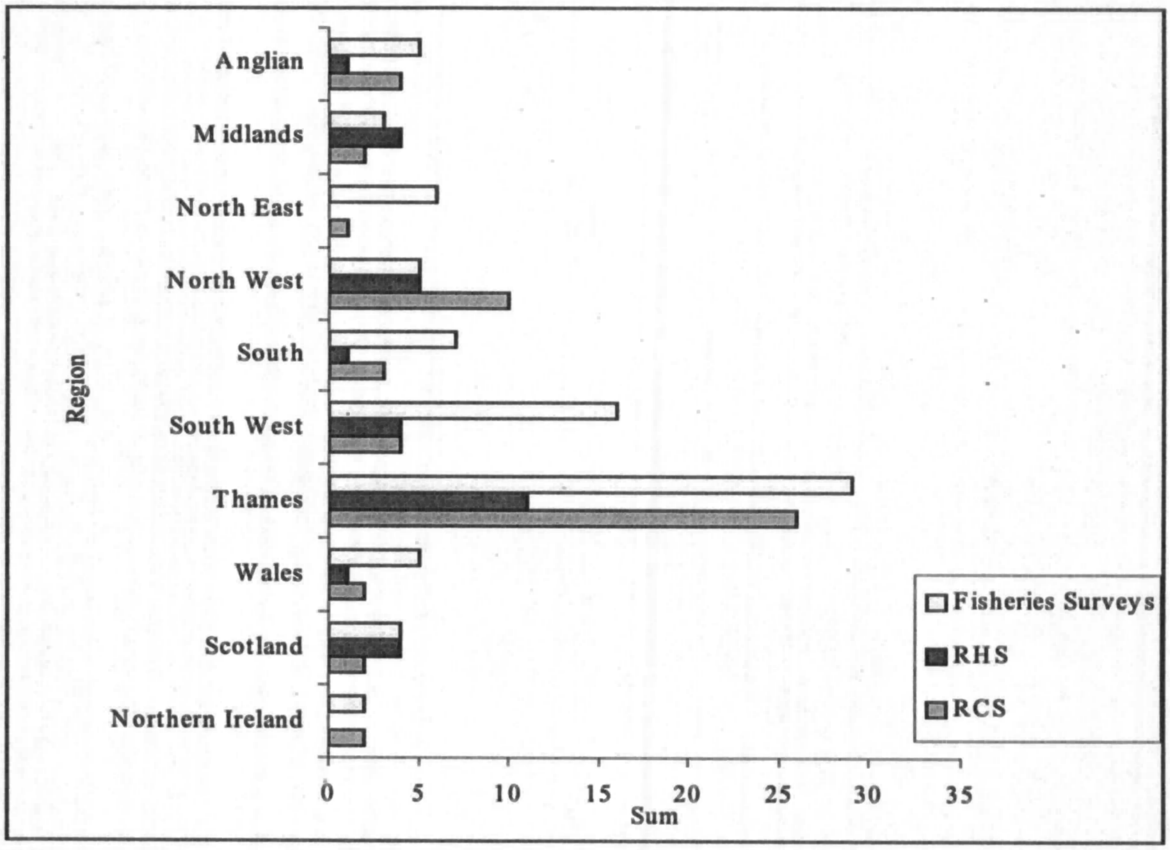
Figure 15. Percentage regional summary of geomorphological appraisal procedures



Ecological appraisal techniques. As can be seen in Figure 16 and Appendix F the most commonly used ecological appraisal techniques were fisheries surveys (35%, 82), RCS (24%, 56) and RHS (13%, 31). This pattern was also mirrored at the regional level, with fisheries surveys being commonly employed in the Anglian (23%, 5), North East (60%, 6), Southern (32%, 7), South West (64%, 16), Thames (35%, 29) and Welsh (36%, 5) regions, and in Scotland (33%, 4) and Northern Ireland (29%, 2). The North West region has focused a great deal on the development and usage of RHS as part of the region's 'Sustainable Rivers Project' (Diamond, 2000: 1). These patterns fit with the results of a survey undertaken by Briggs (1999: 78) who found that monitoring (a component of project appraisal) of vegetation, fish and invertebrates were the most commonly undertaken monitoring techniques on UK river restoration projects.

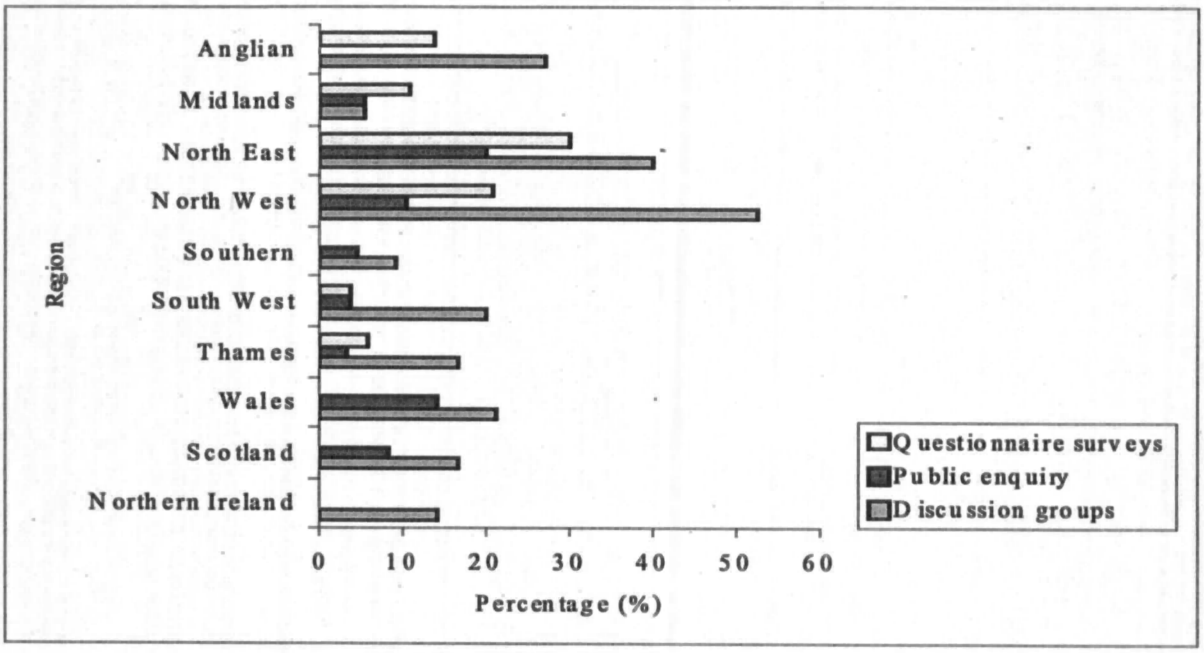
It was demonstrated earlier that fisheries are a major priority in the North West and Southern region. The RRC data (Section 4.3) also showed that fisheries were the main driver behind restoration in Northern Ireland, Scotland, and the North East. However, in the North West region, RHS and RCS were the most frequently employed (26%, 5 and 53%, 10) appraisal technique and in the Midlands RHS (22%, 4) was favoured more frequently. This is also consistent with the RRC data which showed restoration projects in these two regions to have been ecologically driven. Apart from in Scotland, RCS is still clearly favoured above RHS (which is absent from the North East region), suggesting that simplicity is often opted for over rigour. The popularity of fisheries surveys may be related to the stipulation in the Environment Act that the EA develop and maintain all fisheries resources, hence requiring fisheries surveys to be undertaken as a standard procedure. Additionally, EA's corporate plan for 2001-2002 showed restoration for fisheries purposes and the enhancement of biological diversity of UK habitats to be key targets. Often geomorphological and ecological appraisals are linked as the recreation of a specific geomorphological structure is required for the creation of specific fish habitats.

Figure 16. Regional summary of ecological appraisal procedures



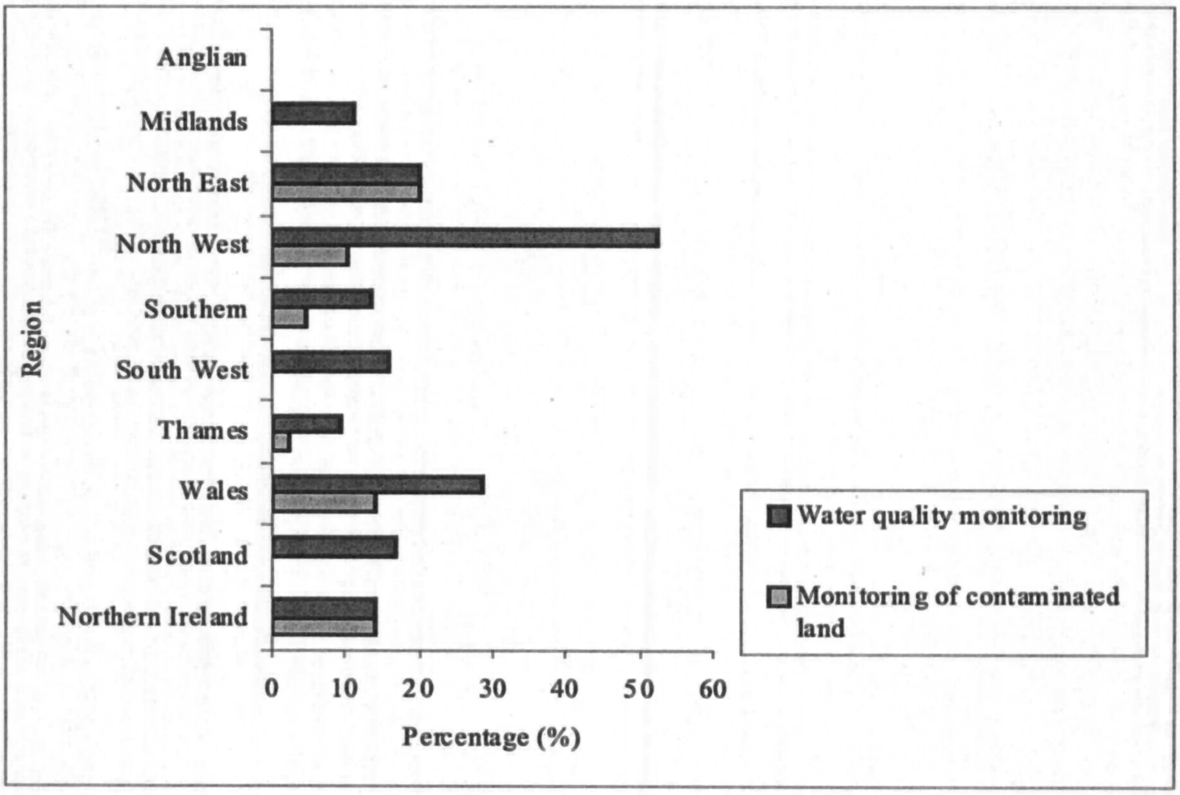
Public appraisal techniques. The regional distribution of public appraisal techniques can be seen in Figure 17 and Appendix G. In Figure 17 it can be seen that discussion groups were the most often employed (21%, 48) public appraisal technique, then questionnaire surveys (8%, 18), followed by public enquiries (6%, 13). Regionally, the North West and the North East employed all three techniques the most, and Northern Ireland and the Southern region the least. The North West is one of the most densely populated regions, hence the need for extensive public participation in environmental projects. In contrast, the Southern region is the smallest of all regions and thus the public appraisal is least undertaken in this region. The Midlands was the only region which employed questionnaire surveys more frequently than any of the other techniques. This may reflect the fact that this region is more urban than rural hence a larger number of people's opinions need to be appraised at each site, therefore there is a need for rapid public appraisal techniques. Chapter 2 highlighted the importance of public appraisal. Although these figures indicate that public appraisal is being undertaken, the extent of these appraisals is seen to be limited.

Figure 17. Percentage regional summary of public appraisal procedures



Pollution appraisal techniques. In Figure 18 and Appendix I it can be seen that the most commonly employed pollution appraisal technique is water quality monitoring (17%, 35). This may be related to the fact that the government uses water quality as one of its headline sustainability indicators. When examined regionally, it is evident that the North West region employed water quality monitoring appraisal techniques the most (53%, 10), possibly related to the fact that this region has poor/bad river quality though the reason for this pattern is uncertain as other regions also possess poor water quality. The North East region had undertaken appraisal of contaminated land the most frequently (20%, 2), perhaps due to its strong industrial heritage. The Anglian region did not employ either of these techniques, a surprising fact give that Table 22 shows agricultural pollution to be a prominent pressure in this region. The Midland region, the South West and Scotland did not monitor contaminated land. The importance of water quality monitoring may be related to the fact that urban runoff has been seen to significantly decrease water quality. This was evident on the River Skerne restoration project. Despite the project's overwhelming success and adoption by its local community, the river's water quality is still poor due to wider catchment issues which means that runoff entering the river is polluted (Rivers of the Future Video: RRC, 1998).

Figure 18. Percentage regional summary of pollution mitigation appraisal procedures



'Other' appraisal techniques. Figures 19 to 20 depict the appraisal techniques included in the category 'other', which included: Cost Benefit Analysis, environmental assessment, landscape assessment, return monitoring (following post-project appraisal) and site visits. All of these techniques were commonly employed in all the regions, with site visits the most common followed by environmental assessments and then landscape assessments. Conversely, in the North East, North West, Southern and South West regions landscape assessments exceeded environmental assessments. In Figure 19 landscape assessments are seen to be more prevalent in the North West region than the Thames region, this is surprising as the Thames region has pioneered the river landscape assessment technique. It is thus likely that this pattern is related to different regional understandings of what constitutes a landscape assessment. Cost Benefit Analysis, return monitoring and site visits were also prevalent in all regions. The prevalence of environmental assessments is likely to be related to the fact that it is legally required that any project with likely environmental impacts undertakes an environmental assessment (see Gardiner, 1992; and Gardiner, 1996).

Figure 19. Percentage regional summary of Landscape Assessments, Environmental Assessments and Site visits as appraisal procedures

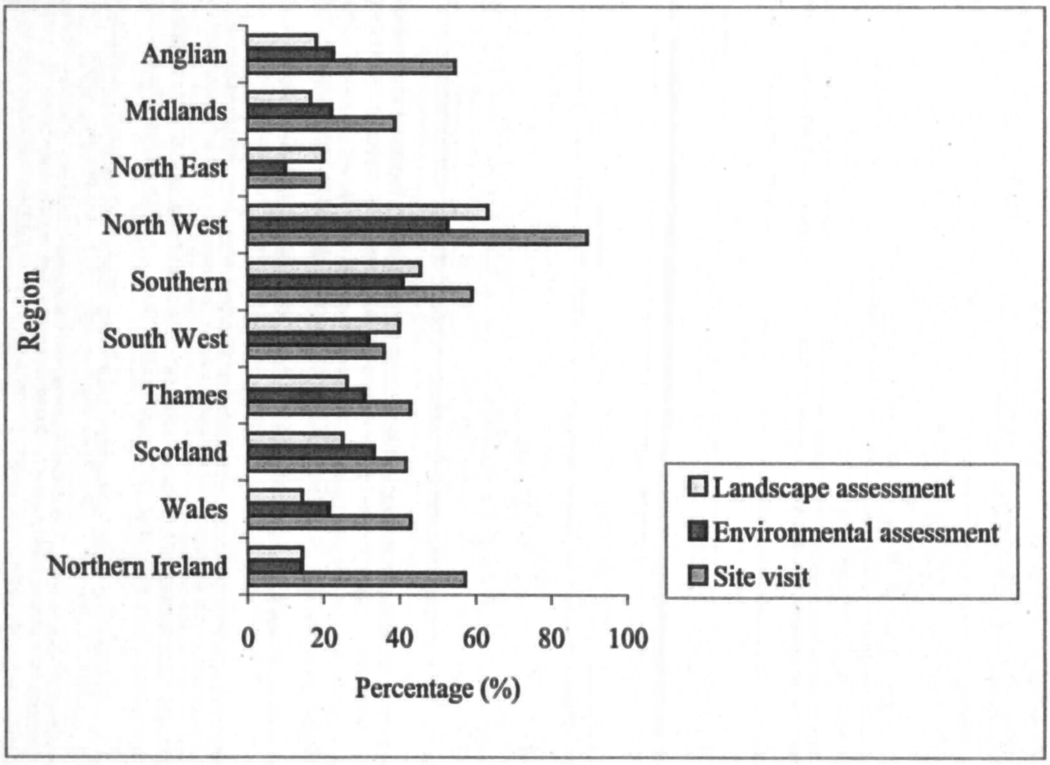
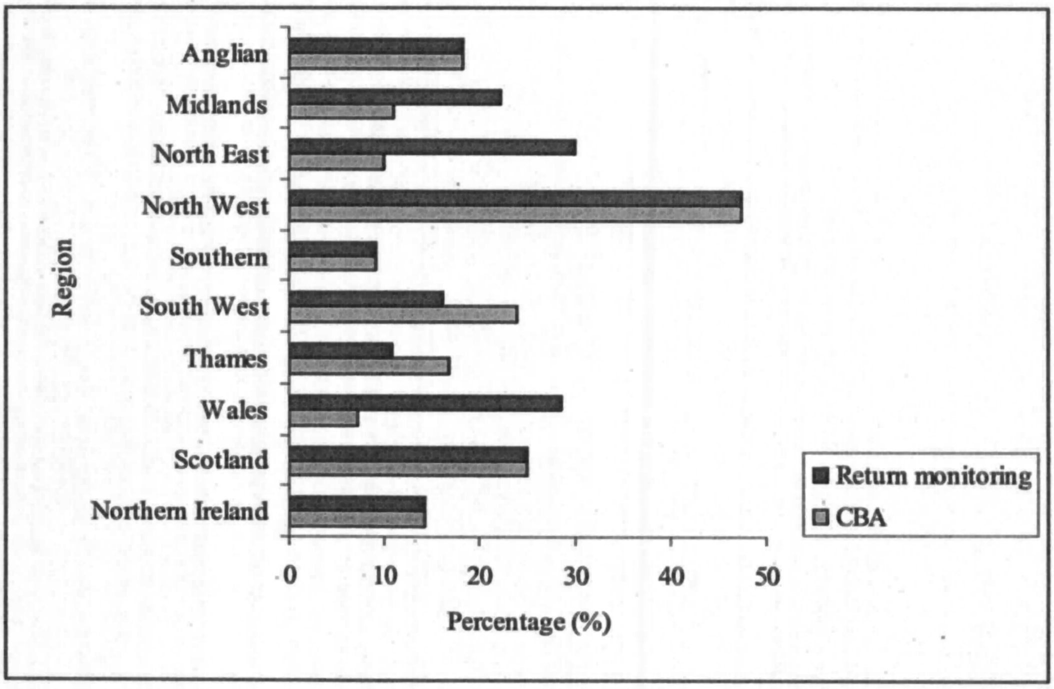


Figure 20. Percentage regional summary of Cost Benefit Analysis and return monitoring as appraisal procedures



4.4.3 Reasons for not appraising

Those questionnaire responses which indicated that project appraisal had not been undertaken are now examined to help ascertain the reasons why appraisals were not undertaken In total 60% (32) of the projects which did not undertake an appraisal gave no reason, 40% (21) did not perceive a need for appraisal, 6% (3) stated that they lacked time and 8% (4) that they lacked money For the remaining 2% (1) money previously reserved for appraisal was diverted to undertake another component of the project

No perceived need In the restoration literature, lack of perceived need for project appraisal has been cited as a prime reason why appraisal is rarely undertaken This assertion is mirrored in these data whereby restoration is often seen as an improvement on the prior degraded state, and hence appraisal is unnecessary

Lack of time and money Some qualitative material which was derived from the survey process can be drawn upon to illuminate the constraints imposed by lack of time and money According to Chris Catlin (EA Conservation Officer North East Thames Region, Personal communication, 05/06/2000) the nature of restoration funding in the UK presently restricts project appraisal as money has to be allocated and spent within a short window of time, with money being available for work on the ground but not for studies This fact was reiterated by Graham Scholey (EA Conservation Officer North West Thames Region, Personal communication, 17/04/2000) who stated that lack of time often constrained him from undertaking appraisals, thus he favoured spending more time on current projects rather than appraisals (Graham Scholey was responsible for 58 separate restoration projects). Hence, appraisal was often seen as a luxury reserved for more significant projects, with anecdotal observation reserved for the remainder of projects In some instances respondents stated that appraisal was also forfeited in order to meet contract deadlines, ensuring that projects did not overstep their budgets In the case of the Medway Rivers Projects, Brian Smith (Medway Rivers Project Officer, Personal communication, 16/03/2000) stated that the project simply did not have the resources or remit to undertake structured appraisals

Other reasons for not appraising According to Dave Webb (EA Conservation Officer South East Thames Region, Personal communication, 05/04/2000), the EA is less likely to appraise restoration projects which are undertaken as a result of developments (e g construction of housing or industrial estates) over projects undertaken purely for enhancement purposes In a similar vein, Graham Scholey (EA Conservation Officer North West Thames Region, Personal communication, 17/04/2000) stated that the EA is only likely to undertake appraisals on their own projects and not on projects which involve other partners

Understanding of what appraisal comprises During this analysis it became apparent that what constitutes appraisal is not always clearly comprehended In three separate cases (Pettys Brook and River Lambourn, Thames region, and the Afon Erddreinio, Welsh region), respondents stated that they had not undertaken an appraisal when in fact they had. In other instances, an informal appraisal was undertaken, whereby a simple statement of a project's success or failure with regard to the achievement of its aims and objectives was made, based on whether a reach looked more 'natural' during a post-project visual inspection These informal appraisals clearly lack scientific rigour, however, they do nonetheless, still constitute a form of post-project appraisal

4.4.5 Summary: general patterns of UK river restoration appraisal procedures

This National Investigation has shown that with regard to project appraisal in the UK

- 81% of river restoration projects have been appraised,
- Nationally, Thames region has undertaken the most appraisals (36% of all appraised river restoration projects in the UK - 84 projects out of a UK total of 232), and
- Nationally, 71% of projects were appraised at the pre-project stage and 66% at the post-project stage
- Nationally the most frequently utilised appraisal techniques were
    - photographs (at pre- and post-project stages),
    - fisheries surveys, and
    - site visits
- Regionally.
    - Thames region employed most geomorphological and public appraisal techniques, and
    - fisheries surveys were favoured by all regions except the Midlands and North West where RCS and RHS were more frequently employed.

This investigation has shown that a diverse range of appraisal techniques have been employed nationally on river restoration projects, with a preference for undertaking quick and cheap techniques such as photography over more time consuming RHSs or fluvial audits Despite the clear presence of appraisal it was seen that there was confusion as to what appraisal comprised with practitioners who had undertaken appraisal not necessarily perceiving their work to be appraisal

4.5 Discussion of results

This section discusses the results of this national investigation of UK river restoration projects and their appraisal procedures. These river restoration projects are assessed in relation to their achievement of the three components of appraisal delineated in Chapter 2 (a catchment basis and the inclusion of geomorphological and public appraisal), examining their regional composition of appraisal techniques, the appraisal techniques employed, the content of project appraisal and project constraints

4.5.1 Regional appraisal patterns

At the regional level (see Table 28, Figure 13 and Table 29) it can be seen that most projects within each region achieved only one of the three components of appraisal The Midlands, South West and Thames regions undertook only five projects each with consideration to the wider catchment The Thames region undertook the most projects with consideration to public participation and geomorphology This pattern is consistent with the region's background in holistic appraisal (including geomorphological and public appraisal)

The high percentage of questionnaire responses which stated that appraisal had been undertaken was encouraging given that appraisal was so infrequently mentioned in the RRC data However, when explored in more detail it was evident that although appraisal had been undertaken the content of these appraisals and the techniques favoured were not conducive to a truly holistic appraisal For project appraisal to be undertaken holistically it was argued in Chapter 2 that it needs to be undertaken from project inception through to project completion following a structured framework of appraisal The appraisal data showed that this was not the case in the UK with appraisal tending to be either undertaken at the pre- or post-project stage, but rarely throughout the project's duration This pattern was consistent with a survey of 53 UK restoration projects undertaken by Briggs (1999 78) who found that twelve projects did not undertake any follow-up surveys after completion If projects are not appraised throughout all stages then it is not possible to be reflective and to learn from earlier stages of the project, thus hindering the advancement of the science and practice of restoration

4.5.2 Appraisal techniques

For all appraised projects it was seen that public participation (28%, 81 projects) and geomorphology (24%, 68 projects) were the two most commonly achieved of the three components of appraisal, with only 11% (32 projects) taking a catchment approach This is consistent with the work of Holmes (1998b 135) who found that, in the UK, river restoration has rarely encompassed both the river and floodplain The same pattern can be seen in the non-appraised projects (though none of course achieve the component of appraisal)

Visual appraisal techniques The techniques employed during appraisal were not wholly conducive to a holistic appraisal from which one could adequately gauge project success or failure, since what has been favoured is the use of techniques which are quick and easy to implement For example, photographs (pre-project 79%, post-project 74%) and site visits (48%) were frequently cited appraisal techniques Although useful as part of a programme of holistic and multidisciplinary appraisal they are of little use individually as they rely purely on subjective observations and individual perceptions of project success or failure. Having said this, if photographs are taken at fixed georeferenced locations then they can be useful appraisal tools, and can also help to explain to members of the public any changes the site may have undergone post-restoration

Geomorphological appraisal techniques The most frequently used geomorphological appraisal technique was channel cross-section measurements (29%) Although useful as part of a more detailed geomorphological survey (e g reconnaissance survey) it has little use on its own, as it simply allows the restorer to see how the channel cross-section has changed following restoration in one single location More detailed geomorphological appraisal techniques such as fluvial audits were only employed on 12% of projects As seen in Chapter 2, fluvial audits enable a much more detailed appraisal of a project's success or failure to be gauged and allow a more catchment-based view to be taken. Although the amount of technical detail included in these appraisals is not great, it is encouraging to see that some forms of geomorphological appraisal are actually being undertaken This compares favourably with the questionnaire survey sent to the EA from which Briggs (1999 27) found that only 3% of EA river restoration schemes had undertaken geomorphological surveys From this same survey, Dangerfield (1999 24) also found that most practitioners favoured the use of their professional judgement (74 5%) in guiding geomorphological river restoration design or else they used baseline geomorphological surveys (13 7%) This information suggests that the inclusion of geomorphological analysis in the design and assessment of river restoration projects is increasing However, there is still a long way to go before the geomorphological appraisal techniques discussed in Chapter 2 are implemented as standard procedure by practitioners It was also seen in Section 4 3 5 that practitioners' understanding of what geomorphological restoration and appraisal comprises is not as detailed or as in-depth as that of a geomorphologist

Ecological appraisal techniques With regards to ecological appraisal techniques, fisheries surveys were most favoured (35% of all appraised projects) This reflected the fact that the main focus of most projects was restoration for ecological or fisheries purposes Although it makes sense that fisheries surveys are undertaken in order to demonstrate whether projects have achieved their fisheries or ecological goals, they should be undertaken as part of a wider programme of appraisal The reason for this is that although fisheries surveys may show an increase in fish biomass they do not enable one to appraise how other species have been affected by the restoration The ecological appraisal data also showed a preference for RCS (24%) over RHS (13%) As seen in Chapter 2, RCS as an appraisal technique is not wholly accurate and is subjective as data are mapped without spatial referencing RHS on the other hand is a far more detailed appraisal procedure and incorporates geomorphological data alongside ecological data and is georeferenced using GIS techniques The techniques employed are not the most accurate for appraising holistically as apart from the RHS they do not give consideration to the importance of geomorphology in project appraisal

Public appraisal techniques Public appraisal techniques favoured the usage of discussion groups (21%) Although it is positive that public appraisals have been undertaken the content of such appraisal is limited, and aside from the rivers Brent, Ravensbourne and Skerne truly participatory and inclusive appraisal of public opinion has been limited If public involvement in a project is limited then its likely success rate may be reduced (see Chapter 2) This was witnessed by the River Skerne's project officer Deirdre Murphy (River Skerne Project Officer, Personal communication, 12/04/2000) and the Skerne restoration project, who found that engaging local children in the restoration process reduced vandalism as 'their big brothers and sisters wouldn't want to damage their baby brother and sister's work' Although it was encouraging to see that projects aimed to work with the local community, which in turn helps ensure public adoption of a scheme, a move towards more bottom-up techniques may be beneficial, encouraging projects to be designed by the public for the public

4.5.3 Summary: UK river restoration projects and appraisal procedures

The National Investigation has shown that

- Nationally
  - no funding is available for undertaking river restoration projects or project appraisal,
  - a diverse range of practitioners from different organisational backgrounds were seen to undertake river restoration projects This led to a diversity of practice nationally and regionally with regards to river restoration and project appraisal,
  - national diversity in terms of pressures upon the natural environmental also led to a diversity of river restoration and project appraisal practice as some regions were more damaged than others and hence necessitated restoring,
  - there was a preference for use of fast and cheap appraisal techniques instead of more in-depth and time consuming alternatives,
  - appraisal was generally undertaken at one stage of a project instead of throughout its duration, and
  - public participation (28%) and geomorphology (24%) were the two most commonly undertaken components of appraisal Consideration of the wider catchment was less frequently part of restoration
- Regionally
  - Thames region was the only region with money set aside for river restoration for the EA's flood defence budget This, combined with the extent of degradation in this region, meant that the greatest number of restoration projects and project appraisals were undertaken here, and
  - Thames region gave the greatest consideration to public participation and eco-geomorphology of all the regions due to a background in holistic catchment management.

Though appraisals have been undertaken on a high proportion of projects, the techniques used to undertake these appraisals have rarely formed part of a truly multidisciplinary programme of appraisal as recommended in Chapter 2 The appraisal techniques utilised lacked the holistic basis which is necessary for gauging a project's success or failure as few projects have been executed within a holistic framework of appraisal which starts at project conception and incorporates post-project appraisal in line with the appraisal framework proposed in Chapter 2

The main constraints on full appraisal were seen in Section 4 4 3 to be lack of both time and money, as the manner in which funding is allocated in the UK prevents project appraisal and forces projects to be executed within a single financial year (Newson and Sear, 1998 18) Additionally, whilst the EA is the main organisation presently undertaking river restoration projects in the UK it does not possess specific funding for undertaking river restoration projects and river restoration project appraisal It was also demonstrated that the EA does not possess a statutory responsibility to include appraisal, geomorphology or public participation in river restoration projects In Section 4 4 3, it was seen that there was confusion amongst practitioners as to what appraisal really involves These constraints combined to prevent projects from being undertaken in a truly holistic manner within a framework of project appraisal

Whilst a range of factors were seen to constrain both river restoration and project appraisal, it was also shown that despite the lack of an institutional framework or individual body responsible for river restoration in the UK there is a wide range of organisations engaged in the practice of river restoration These organisations were seen to have developed a broad range of river restoration and appraisal techniques to contend with the diverse range of environmental pressures evident across the UK enabling projects to be undertaken and appraised (at a range of levels) within tight budgets

4.6 Conclusion

This chapter has described how a wide range of environmental policies governing water resource management are in existence in the UK, and also a wide range of restoration and appraisal techniques have been employed on restoration projects Despite these two facts there does not exist a common protocol or framework (such as the framework put forward in Chapter 2) to guide the undertaking of river restoration projects or project appraisal The undertaking of appraisals was also inhibited by a lack of clarity amongst practitioners as to what appraisal comprises, by the fact that appraisals were generally undertaken on a one-off as opposed to continual basis, and also by the preference for using rapid and cheap techniques over more in-depth and costly alternatives (which could potentially yield the greatest insight into a project's success or not)

This national investigation of river restoration appraisal procedures is the first of its kind Although it has made possible a broad review of the nature of appraisal and river restoration in the UK, it has inevitably lacked detail on the precise nature of the project appraisals concerned This is because the questionnaire survey lacked room for respondents to provide much detail of their appraisal procedures. For example, on the rivers Brent, Ravensbourne and Skerne projects the researcher knew that detailed public appraisal had been undertaken, however, during the questionnaire's analysis the precise nature of these public appraisals was not evident In hindsight the researcher could have benefited from asking questions regarding the financing of project appraisals in order to assess more fully the factors which constrain project appraisal. These insufficiencies reflect flaws in the questionnaire and also the amount of information that each respondent gave during their questionnaire response However, despite this the questionnaire enabled the researcher to gain a national overview of the nature of project appraisal in the UK as a high response rate was achieved, possibly due to the concise nature of the questionnaire survey.

In order to examine the nature of project appraisal in more detail it is necessary to focus in at the regional level and to examine case studies which are known to have undertaken appraisals which included geomorphological and public components and also involved the usage of appraisal frameworks to guide the projects The use of these case studies can enable the researcher to investigate in greater detail how appraisal is undertaken, and to examine the factors which influence project appraisal, such as funding, decision-making structures and the role of individual decision makers This investigation will provide a depth of examination which was not possible in the national investigation

The Thames region was selected for this regional investigation as it had a history of holistic river management and appraisal, and, according to Slater *et al* (1994· 390), the water sector has always been at its most advanced where it is under greatest pressure Additionally, the results of this national investigation showed this region to have undertaken the most restoration projects and the most appraisals of all the regions This is inferred to be largely related to the fact that this region of the EA has money set aside for restoration projects unlike other regions A strong focus on geomorphological and public restoration and appraisal techniques was observed, the latter of which is possibly related to the region's programme of early consultation and liaison with stakeholder groups (Fordham *et al*, 1991 184) This regional investigation is presented in the following chapters Chapter 5 provides a background to the Thames region of the EA and to the selected case studies, and Chapters 6 and 7 examine their decision-making and appraisal frameworks and techniques

Chapter 5. Thames Region Investigation: evaluating river restoration decision-making structures

5.1 Introduction

It was indicated in Chapter 4 that the Thames region of the EA is one of the most heavily impacted regions of the UK, with some of the country's largest and densest urban areas and intensive agricultural practices within its rural locations This region was also seen to have undertaken the greatest number of river restoration projects with project appraisals specifically focusing on geomorphological and public appraisal techniques These factors underline the rationale (as seen in Chapter 3, Section 3 4) for selecting the Thames region as the focus for a regional investigation of river restoration appraisal procedures.

In order to undertake this regional investigation three case studies were selected (see Chapter 3, Section 3 4 2 for site selection rationale)

- The Queen's Mead Recreation Ground (QMRG) project in Bromley (South London), an example of an urban river enhancement site,
- The completed Cole River Restoration Project (CRRP) on the Oxon/Wiltshire border, chosen as a rural case study, and
- The Upper Kennet Rehabilitation Project (UKRP) near Marlborough (Wiltshire), which was selected as an example of an on-going chalk stream rehabilitation project

These three case studies were selected in order to facilitate a more detailed examination of the process of project appraisal than was possible in the national investigation Chapters 5 to 7 use these case studies to evaluate project appraisal in action and within the context of the Thames region's policies and practices Through this case-study based investigation it was possible to examine the appraisal structures and decision-making structures employed This examination enables the geomorphological and public appraisal techniques employed on the projects to be explored in detail, along with the extent to which the projects were developed from an initial consideration of the catchment context (as discussed in Chapter 2) The manner in which these projects were appraised is then evaluated against the idealised three-phased appraisal framework delineated in Chapter 2 This facilitates the recording and analysis of where and how successes have been achieved, where and why difficulties were encountered, enabling the documentation of emerging ideas on 'good practice'.

The main focus of this chapter is the decision-making structures employed on the three case studies The chapter traces in detail how and why different decision-making structures were devised in each case and the effects of those structures on the restoration projects concerned Decision-making processes are seen here to be a means of legitimising decisions through consultation with stakeholder groups, and the procedures used in decision making are seen to be as important in this respect as the decisions which are made (Jackson, 2001 136) The rationale behind this is that it is not only a project's appraisal structure which influences its final design and implementation The manner in which decisions are made, and the structure of the decision-making process also shapes a project's appraisal and trajectory In order to better understand the process of environmental decision making the role of science in environmental management is first discussed (section 5 2) The remainder of this chapter is divided into four sections·

- *Section 5 3* provides background context to the region, justifying its selection on the grounds of its history of holistic appraisal, including public and geomorphological appraisal,
- *Section 5 4* provides background information on each of the three case study sites, discussing catchment and reach characteristics, and the reasons why these sites were selected for restoration,
- *Section 5 5* compares the different approaches to decision making employed on the case studies and demonstrates the differences between them, and
- *Section 5 6* concludes this chapter setting the scene for Chapters 6 and 7 where the decision-making and appraisal structures are evaluated together

Overall, this chapter argues that each individual restoration project potentially possesses different physical and environmental characteristics, different causes of environmental degradation and also different reasons for undertaking river restoration This non-homogeneity affects the structure of decision making Furthermore, it is argued that decision making and appraisal are closely interlinked and act in unison influencing a project's trajectory and potential success. Therefore, the creation of all-encompassing decision making and appraisal structures to be utilised on all projects may not be feasible

5.2 The role of science in environmental management

Wilson and Bryant (1997. 19) suggest that 'social and environmental uncertainty is the greatest problem facing environmental managers ' For example, in the face of the uncertainties produced by global warming, scientists now recommend a process of 'managed retreat' in coastal zones, and with regards to rivers the EA now recommends that new developments should not be constructed within the one hundred-year flood zone These examples highlight the uncertainty of scientists in their attempts to minimise risk and to manage natural processes which are often dynamic and unpredictable and hence difficult to suggest appropriate management decisions for Today the public is increasingly demanding a level of scientific certainty which scientists can not provide, and this is in turn leading to increasing public mistrust of science According to Beck (1995 60), we are entering a phase of 'reflexive scientisation' whereby society is turning to alternative forms of knowledge in order to comprehend environmental processes This mistrust of scientific knowledge emphasises the need for greater public involvement in environmental decision making, as undertaking decisions without the consensus and inclusive involvement of all stakeholder groups has the potential to not only increase this mistrust but also to reduce the potential success of a project by ignoring alternatives to scientific knowledge

Despite these debates, environmental management in Western society still remains characteristically technocentric (Bryant and Wilson, 1998· 324) and driven by expert-based scientific knowledge This scientific basis affects the manner in which decisions are made and projects designed, presently giving limited scope for the inclusion of more ecocentric alternative lay knowledges (see Shiva, 1991, and Sachs, 1993) River restoration projects can illustrate this point These projects are inherently scientific as they are effectively civil engineering schemes which incorporate the concepts of ecology and geomorphology within their designs However, they are also distinctly social in that they are usually undertaken in public locations (e g parks) or in close proximity to urban developments Thus, the practice of restoration is at once scientific (or technical) and social, and it is through decision making and project appraisal that these are brought together in the development of projects that are potentially sustainable both environmentally and socially Scientists and the public are not homogeneous groups and there can be divides amongst as well as between them on whether and how a project should be undertaken

In each of the following river restoration case studies the scientific backgrounds of the decision makers, and the organisations within which these decision makers operate, influence both the nature of and the manner in which decisions are made In examining the decision-making structures employed on the following three case studies it is proposed that these structures need to possess in some degree the following three qualities

1 Effectiveness – the ability to make and implement decisions,
2 Inclusiveness – the ability to involve all those who should be involved, and
3 Legitimacy – the ability to secure consensus on their decisions

Effectiveness In order to be effective decision making must facilitate the development of the most appropriate restoration options for the site in question Chapters 1 and 2 showed that river restoration projects can be guided through the use of a three-phased project appraisal framework, with appraisal seen as a framework for logically planning and executing a project, with consideration to the catchment, eco-geomorphology and public participation Hence, for decision making to operate effectively the decision makers need to give adequate consideration to the components of this framework when making their decisions and undertaking their appraisals This chapter provides context and background for Chapters 6 and 7 which examine the effectiveness of decision making, and evaluate the appraisal structures and techniques employed on the case studies In these chapters the manner in which the appraisal process is influenced by the structure of the decision-making process and the ways in which the decision-making process is influenced by the appraisal process is examined, evaluating the similarities and differences between the appraisal structures utilised in the case studies and the model proposed in Chapter 2

Effectiveness also involves the ability to implement decisions In order to facilitate the effective implementation of decisions, decision making and decision makers must be sufficiently powerful, as in the absence of the required statutory or institutional power decisions cannot be effectively implemented Additionally, at the level of the individual decision maker, an individual's power within a decision-making structure can influence both effectiveness and the ability for a project to be implemented This is because powerful individuals can either reduce or enhance effectiveness, enforcing their views upon the decision-making group Similarly, an individual could hinder or enhance a project's implementation through his or her power within and outside of the decision-making group

Additionally, according to Funtcowicz and Ravetz (1993), in order to develop effective solutions to environmental problems there is a need to extend environmental expertise beyond traditional scientific qualifications and to incorporate alternative knowledge bases, not in order to replace but to complement science Effective decision making should therefore involve a range of knowledge bases as both effectiveness and the ability to implement decisions are influenced by the composition of the decision-making group and also by the power of the individuals who make up this group These issues will be returned to and discussed in Chapters 6 and 7 but here they demonstrate that the effectiveness of decision making is connected to its inclusiveness.

Inclusiveness According to Eden (1998 428-429), in environmental science there exists a dichotomy between 'expert' and 'lay' knowledge This prioritises 'experts'' ability to 'speak for the environment,' while the public are seen as irrational and are disqualified from environmental debate However, as was argued in Chapters 1 and 2, the public often possess a great depth of localised environmental knowledge which can be of vital importance in river restoration projects. Therefore, in order to be effective, decision making must also be inclusive It needs to involve all those individuals who have contributions to make or stand to be affected by the decisions being made (see Chapter 2 Section 2 1) Hence, decision making should not solely include experts or policy makers, it needs to fully identify all stakeholders and involve them from the early stages of a project throughout its duration However, undertaking a fully inclusive project could clash with the development of an effective project For example, the geomorphological efficacy of a project may be reduced if non-scientific stakeholders do not agree with the design plans produced by a geomorphologist Although inclusiveness is necessary for gaining the consent and support of all stakeholder groups it is important to achieve a balance in decision making so that designs are, on the one hand, scientifically effective, and, on the other hand, socially acceptable These tensions between scientific and lay knowledges are discussed further in Chapter 7 when the effects of the decision-making structures on appraisal are evaluated Gaining an appropriate balance between scientific and lay input in a project can be pivotal to a project's success both physically (i e the restored river's ability to perform naturally) and socially (its acceptance by local communities) This connects the effectiveness and inclusiveness of decision making to its legitimacy

Legitimacy The third quality of decision making should be legitimacy Painter (1995 17) sees legitimation as a process whereby frameworks of meaning are used to make forms of authority seem legitimate On river restoration projects, decisions can be legitimised through inclusiveness and through science. Inclusiveness can legitimise decisions through the securing of consensus, ensuring an equitable sharing of decision-making power between lead decision makers and all stakeholder groups If decision making is not inclusive, then the effectiveness of decision making is reduced and so is its potential implementation, as those groups or individuals not consulted could oppose the project and prevent it from going ahead Conversely, decisions can also be effectively legitimised through science For example, a scientifically legitimate and environmentally sustainable project could be produced through use of expert knowledge alone This, however, risks offending local stakeholder groups which are increasingly demanding input into decision-making processes by ignoring the incorporation of their localised knowledge Again, a balance is required between legitimisation through inclusiveness and through science If too much power is conferred to specific groups then their decision making may lead to the creation of a project which is environmentally and/or socially unsustainable and hence ineffective However, striking a balance and including more people in the decision-making process can reduce the ability to make legitimate and effective decisions as it may reduce the power of science or the voice of the expert According to Pennington (2000. 59-60), 'the active involvement of interest groups or "stakeholders" within the political process is essential if the full spectrum of public preference is to be properly reflected and a process of democratic consensus building is to occur'. This point is emphasised here as the practice of river restoration is at once both scientific and social so that projects must include both experts and stakeholder groups in decision making However, finding a workable balance to enable the implementation of effective, inclusive and legitimate projects is problematic and, as seen in Chapter 2 and in the remainder of this chapter, there exists no one model for achieving this balance

Building on these ideas, the following chapters examine the decision-making and appraisal structures employed on the three case studies, exploring the ways in which decisions are implemented (and their effectiveness and inclusiveness) and legitimated through the balancing of different knowledge bases The chapters show the effects that the nature of decision making has on project appraisal, and *vice versa* It is argued that the individual decision-making structures are very different as they respond to localised circumstances such as the individual river's environmental characteristics, the reasons and causes of the river's degradation and the site's setting (e g urban or rural) Additionally, the reason why restoration was initiated influences how decision making is undertaken, who is involved in the decision-making process, and the differential roles of science and public participation within a project The following section now discusses the background to the case studies by setting them in the context of the Thames Region

5.3 Background to the Thames region

The Thames region of the EA covers the entire river Thames basin from its source in Gloucestershire, through Wiltshire, Oxfordshire and London, to its estuary in Essex (EA, 2002) The region comprises both highly urban and intensively farmed rural locations (EA, 2000a 65), and three area offices and a regional head office in Reading have been set up to deal with these intra-regional differences The South West area (Wallingford) is responsible for mainly rural areas such as the Chilterns The North East area (Hatfield) is responsible primarily for urban brownfield sites with the highest pace of development of all the Agency area offices The South East area (Camberley) is also in charge of urban waterways and has undertaken many river restoration projects within Greater London The Head office has been responsible for both urban and rural projects in and around the region and in conjunction with these area offices

As was seen in Chapter 4, the Thames region is unique in that a proportion of its annual Flood Defence revenue budget is used to implement habitat enhancement initiatives Also, in this region Area Liaison Teams from across a range of departments are in charge of prioritising which enhancement works should be undertaken (EA, 1998a 27). In Chapter 3 it was demonstrated that the Thames region has had a long history of catchment-based project appraisal as it was a frontrunner in the development of Catchment Management Plans in the 1980s. This catchment-based approach led to the integration of the planning sector in the development of Best Practicable Environmental Options, which has helped to create prioritised master plans such as the Maidenhead to Eton Wick flood defence scheme (Gardiner, 1988. 445) This history of holistic environmental management is also linked to the extent of the environmental pressures within this region, which has necessitated a strategic and planned approach to environmental management Newson (1997 305) believes that this approach was also adopted because, as a public authority, the EA Thames region believed it had to demonstrate that all relevant factors had been properly considered during a project, providing an appreciation of the impacts of a proposal, and ensuring the efficient implementation of projects

Chapter 4 showed that as part of this region's holistic approach, Thames has sought, to a greater extent than other regions, to incorporate geomorphological and public appraisal techniques into project design and implementation The following three Thames region case studies should be understood within this context of more holistic approaches to environmental management developed to deal with the region's diversity of environmental pressures (detailed in Chapter 4), whilst also repairing the damages done to watercourses by the EA's predecessors throughout the past decades

5.4 Background to the river restoration case studies

The three projects selected for analysis in this investigation (QMRG, CRRP and UKRP) differ fundamentally First of all, the QMRG project is an urban project located in Bromley This project was initiated as a partnership project between the EA and London Borough of Bromley, with input from numerous consultants and the local community This project originally emerged during a phase of research into the public perception of flood defence and river restoration projects which was undertaken at the same time that strategic plans (e g Maidenhead flood defence scheme) first began to be developed The project has subsequently undergone extensive appraisal and design since the early 1990s However, funding difficulties and concerns over increased flood risk have led to this project being stalled, and it has not yet been undertaken The rural CRRP differed significantly to the QMRG as it was led by the RRP (as opposed to the EA) as part of an EU Life river restoration demonstration initiative, and is today recognised as one of the world's most heavily monitored river restoration sites (Sear *et al*, 1998) The chalk stream based UKRP differed from both the completed projects, not only because it was led by Thames Water, but also due to its highly multidisciplinary team and the fact that the project had emerged from a public inquiry into Thames Water's groundwater abstractions In what follows, these projects are set within their catchment and site contexts, and their conception as restoration/rehabilitation schemes is discussed, providing a background to the description and evaluation of the decision-making structures employed on the three projects

5.4.1 Background to Queen's Mead Recreation Ground project

QMRG's catchment characteristics (Table 31a and 32a) QMRG is located on the river Ravensbourne which drains 180km^2 of main river within the Thames catchment With its headwaters in the North Downs (NRA, 1992a 7), and its source rising at Keston Common (Orpington), the Ravensbourne flows in a northerly direction for 17 3km, entering the Thames at Deptford This catchment is one of the most highly urbanised in the UK 37% (26km) of the Ravensbourne has been culverted and 83% of the channel is contained artificially (Copas, 1997 119) Only 8km of the channel maintains a meandering form These few remaining sections are generally found in areas of Green Belt and formal parkland (e g Beckenham Palace) Hydrologically, the Ravensbourne is extremely flashy, resulting from the impermeable and dense networks of roads and homes which have built up in the catchment over the past century. Flood risk has always been a serious issue within this catchment (NRA, 1992a 1), and has resulted in extensive channelisation to both accommodate development within the floodplain and protect property from flooding Channelisation has had dramatic eco-geomorphological consequences The construction of weirs and deflectors has meant that sources of sediment and zones of sediment transfer and storage have been either disrupted or new ones created, resulting in 23km (53 1%) of the channel being classed ecologically as 'poor' (NRA, 1989a, NRA 1989b; and NRA, 1989c) The existence of a fragmentary river corridor impedes the movement and dispersal of wildlife upstream and downstream, and an absence of in-channel features and reach heterogeneity has led to low fish and invertebrate populations (Babtie, 2000 6)

QMRG's site characteristics The QMRG reach (300m) is located on the Ravensbourne in Bromley (see Plate 1) The river enters and leaves the park through two culverts (constructed in 1912) which subdivide the park into two halves (the recreation ground and St Martin's Hill) The river is contained in an asymmetrical channel surrounded by high metal fencing which prevents public access Maps from 1710 and 1861 show this site to have once been an area of open fields and marshy floodplain with a meandering channel running through the middle. It has, however, been argued by Andrew Brookes (in Tapsell *et al*, 1992 2) that by 1710 the Ravensbourne had already been straightened for agricultural land drainage purposes As the twentieth century dawned it brought accelerated changes to the catchment Rapid development on the floodplain increased the surface run-off rates, causing a flood in 1968 which badly affected local properties and businesses In response to this event the Greater London Council (responsible for flood defence at that time) decided to channelise the river through QMRG Although these flood defence measures were locally welcomed, Tapsell *et al* (1992 4) found that the people of Bromley were sad to lose their river's rural beauty as it had great local importance

Table 31. Catchment characteristics

a) River Ravensbourne	
Total area of catchment (including areas south of chalk line)	180 km^2
• Area of the river system catchment (north of the chalk line)	112 km^2
• Built-up area of the river system catchment	80 km^2
• Unbuilt area of the river system catchment	32 km^2
Total length of river system.	70 km (100%)
• Natural river in straightened section	13 km (18%)
• Natural meandering river	8 km (11%)
Length of river:	
• Culverted	26 km (37%)
• In concrete channel	14 km (20%)
• With artificial walls with natural base	4 km (6%)
• With toe boarding	5 km (7%)
b) River Cole	
Total area of catchment	129 km^2
Total length of river system.	22 7 km
• Drainage network	166 km
• Drainage density	1 29 km^2
Landuse	
• Built-up area of the river system catchment	19 35 km^2 (15%)
• Pasture/grassland	30 km^2 (25%)
• Arable/agricultural	77 4 km^2 (60%)
c) Upper River Kennet	
Total area of catchment	164 km^2
Total length of river system	98 km
• Main stream length	318 km
• Flood defence length	314 km
• Natural meandering river	13 230 km (4 1%)
Length of river	
• Culverted	0 421 km (0 1%)
• Channelised	2 983 km (0 9%)
• Navigable	43 022 km (13 6%)
• Percentage of channel shortened	20-25%

Table 32. Catchment and channel modifications

a) River Ravensbourne	
• Intense period of urbanisation	1800-1900
• Development on the floodplain	1800+
• Advent of the railway increased urbanisation	1850
• Culverting and channelisation	1920-1930
• Increased rates of development in the catchment	
• Green Belt Act halted development in South of catchment	1944
• Development continued in North of catchment	1950-1960
• Flooding of Queen's Mead Recreation ground	1968
• Flood alleviation schemes introduced	1963-1975
• Catchment appraisals recognised need for river restoration	1988-2001
• Plans for river restoration at QMRG developed	
• Change in land management in inter- and post-war periods	1900-2000
b) River Cole	
• Planform stability	1600-2001
• Drainage	1600-1930
• Piecemeal channelisation and mills structures constructed	1600-1940
• Channel desilting	1920-1990
• Land drainage	1930-1990
• Conversion to arable farming	1940s
• Urban culverting and development of Swindon	1950-1990
• Restoration project undertaken	1990s
c) Upper River Kennet	
• 1810 Canal constructed	Pre 1900s
• Urbanisation	
• Mills and local channel realignment, channelisation	
• Reduced floodplain management	1900-1930
• Agricultural drainage and realignment	1942-1947
• Increasing abstraction	1962-1965
• Urban culverting	
• Axford pumping	1970s
• Axford enquiry (won in 1996)	1990s
• Rehabilitation options developed	

Sources EA, 1997, EA, 1999 and EA, 2000e, NRA, 1992a, NRA, 1992b, and Sear and White, 1994 2

Plate 1. River Ravensbourne at QMRG (photo taken from Queensmead Road culvert, 18/06/2001)

Reason for restoring the QMRG. The original idea for the QMRG restoration project was conceived in the 1980s, when John Gardiner (then Technical Planning Manager for the NRA Thames region), commissioned a collaborative project between NRA Thames region and the FHRC at Middlesex University. This project examined local people's perceptions of river restoration, focusing on a hypothetical channel restoration project on the Queen's Mead site. Following an initial public perception study in 1992, widespread public support meant a decision was made to implement the project. Subsequent appraisals cited flooding, ecology, geomorphology and aesthetics as the main reasons for restoring the Queen's Mead reach (archives held at EA Thames region in Reading). Intense urbanisation and channelisation within the catchment had increased flood risk with areas of natural flood storage being lost as more and more of the floodplain was being consumed for development. The intensified urbanisation of the catchment also destroyed the channel's natural geomorphology with most stretches of river being channelised, leading to a disrupted sediment transport regime. Restoration was seen as a remedy option to decrease flooding (by allowing flood waters to be stored on the floodplain) and also to prevent gravels being completely washed through the QMRG reach of the Ravensbourne during peak flow events. Channelisation had also had negative ecological consequences leading to low biological and habitat diversity, which was exacerbated by poor water quality and pollution. Restoration offered the chance to aid the development of more diverse river habitats (Babtie, 2000: 44), and to reconnect this 300m reach to less disturbed sites (upstream and downstream). This would improve the river geomorphologically restoring sediment transport and deposition process whilst also creating a more diverse river habitat by reconnecting the river to its floodplain and recreating a river corridor. Aesthetically, restoration and enhancement (both terms being used interchangeably on this project) would also improve the park for recreation with substantial benefit to the local community, ameliorating an area of public open space in a residential urban setting (in keeping with Bromley's Unitary Development Plan) Restoration would also have the potential to act as a flood storage reservoir for downstream Lewisham

5.4.2 Background to Cole River Restoration Project

CRRP's catchment characteristics (Table 31b and 32b) The River Cole is a fourth order tributary of the Thames located in a small lowland catchment of 129km^2 It starts its course in a spring-fed chalk escarpment in Swindon (Wiltshire) and flows north (RRP, 1995 2 1) to Oxfordshire where it enters the Thames at Lechlade (Vale of the White Horse District) This catchment has been settled and farmed for centuries (Eden *et al*, 2000 258), and throughout the past 500 years it has been heavily modified, with channels being straightened for milling and for land drainage schemes in the 1960s. The steady urbanisation of Swindon in the Cole's headwaters has exacerbated these modifications, leading to the Cole becoming divorced from its floodplain, resulting in a loss of ecological and hydrological contiguity (Driver, 1997 371). On the pre-restoration river Cole there was no evidence of reaches which had not been deepened or straightened (Sear and White, 1994 11) Prior to being straightened the river had once been characterised by sinuosity values of 1 31-2 08 and stable banks lined by vegetation (Briggs, 1999 126) Through time bankfull width had increased by 255% and depth by 328% (with bed levels dropping by 2m), resulting in low width-depth ratios in some reaches (Sear *et al*, 1998 180) Since being restored (1994-1996), planform stability and lateral stability have been created by the aggradation of cohesive fines on the floodplain, exacerbated by the clayey (immobile) geology of the catchment (Sear *et al*, 1998 173) These morphological changes have had ecological repercussions, and, although there is good species diversity, no species of exceptional rarity are present today (RRP, 1995 3 2) The catchment has also developed a flashy flow regime caused by its high clay content (55%), agricultural drainage and heavy urbanisation in the river's headwaters

CRRP's site characteristics The CRRP site (see Plates 2 and 3) is located in the village of Coleshill, downstream of Swindon on the Oxon/Wiltshire border (10km from the Thames) The site is 2km long and encompasses a 50ha floodplain crossing through the Buscot and Coleshill estates (3,620 acres), both owned by the National Trust Coleshill is an area of local landscape importance, encompassing a conservation area, ancient woodland and the Great Western Community Forest (RRP, 1995 4 1-4 3) Historically, the Cole used to inundate its floodplain and was known locally as *Lenta* (Welsh for flood stream) However, the channel was first straightened 350 years ago to feed the estate's mill, and deepened in the 1970s for drainage (Holmes, 1998b 140), resulting in an almost entirely artificial watercourse The low energy nature of the Cole, combined with its morphological stability, meant that it was incapable of nature of the Cole, combined with its morphological stability, meant that it was incapable of overcoming these degradations. River restoration offered an opportunity to reverse these changes, improving the river and its floodplain whilst simultaneously acting as long-term flood storage for the Thames by decreasing flood peaks further down the catchment. The site was divided into four reaches for baseline monitoring and post-project appraisal: a control reach and a restored reach (upstream); and a restored and impact reach (downstream). The upstream section was previously widened, ponded and controlled by the mill weir. The downstream reach below Coleshill bridge was overly wide and deep prior to restoration.

Plate 2. River Cole and floodplain, river in flood (upstream restored reach, 17/01/2000)

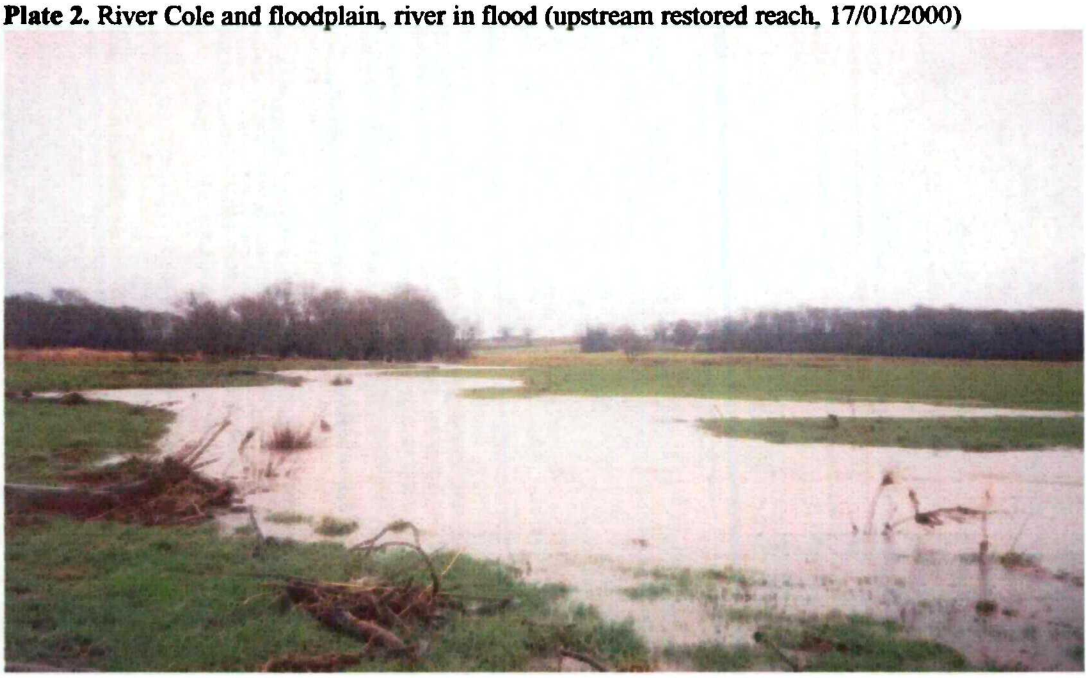
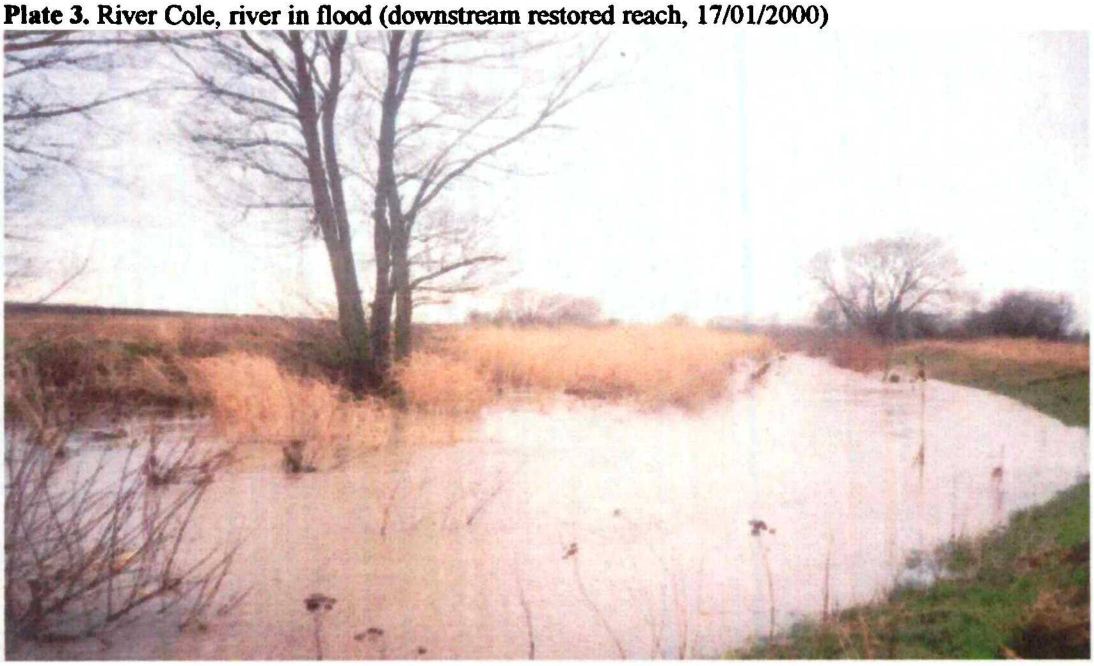


Plate 3. River Cole, river in flood (downstream restored reach, 17/01/2000)



Reason for restoring the CRRP The CRRP was inspired by a river conservation conference which took place in York in 1990, where a group of like-minded individuals recognised a need 'for a national catalyst to encourage, and help facilitate the restoration of rivers' (Holmes, 1998b 134) At this time the NRA were increasingly frustrated because financial constraints limited them to small-scale enhancement projects, and 'there didn't seem to be any organisation that could on its own do large-scale restoration, where we could demonstrate large-scale benefits' (Alastair Driver, Interview, 21/02/2001) The perceived need for a national river restoration body meant that in 1991, following the conference, the RRP became established as a non-profit making company part funded by the EA. The sole aim of this centre was to promote the restoration of degraded rivers (Holmes, 1998b 135) and to demonstrate state-of-the-art restoration techniques From the outset the RRP saw restoration as a 'visionary target of pristine rivers that are wholly returned to an undisturbed state requiring no management' (Holmes, 1998b 139) Once formed, the RRP in conjunction with the NRA and English Nature made an application to EU Life to fund two river restoration projects in the UK It was anticipated that 'if we could actually restore successfully two major river sites, then it would influence future thinking' (Richard Vivash, Interview, 13/03/2001) It would also promote river restoration nationally and internationally Once the funding was gained in 1993 a process of site selection was embarked upon, and the River Cole was selected to demonstrate river restoration in a rural context

5.4.3 Background to Upper Kennet Rehabilitation Project

UKRP's catchment characteristics (Table 31c and 32c) Located in the North Wessex Downs, the upper river Kennet (Plate 4) rises by Avebury (Wiltshire), and flows via Marlborough, Axford and Knighton, before entering the Thames at Reading The Kennet is the largest tributary of the Thames catchment (EA, 1999 1) It is 98km long, with seven major tributaries, draining an area of 1,164km^2. The Kennet rises on lower chalk (at c290m Area Over Datum) and flows over chalk downlands It is thus fed from a chalk aquifer, resulting in a generally stable flow and temperature (Crafer *et al*, 2000 60) Historically, the catchment used to be dominated by water mills and arable farming Today the catchment's floodplains are still farmed (mainly pasture) and Marlborough is the most highly urbanised area The river is also a game fishing resource, with land between Marlborough and Knighton falling under private ownership The Upper Kennet catchment (295km^2), defined as the stretch of river upstream of Knighton gauging station (Sawyer and Fordham, 1994 2), has been classed as an Area of Outstanding Natural Beauty, and an area of high ecological value, containing 300 wildlife heritage sites and 50 SSSIs As an SSSI, the Kennet is considered as a key habitat within the UK's BAP and the EU's Habitat Directive (see Table 33 for list of protected chalk stream species)

Table 33. Some of the key protected species endemic to chalk streams

Fish:	Brown trout (*Salmo trutta)*, Brook lamprey *(Lampreta planeri)* and Salmon (*Salmo salar)*
Invertebrates:	Crayfish *(Austropotamobius pallipes)*; Desmoulin's whorl snail *(Vertigo moulinsiana)* and Southern damselfly *(Coenagrion mercuriale)*
Mammals:	Water vole *(Arvicola terrestris)* and Otter *(Lutra lutra)*
Plants:	Water crowfoot *(Ranunculus penicillatus)* and Watercress *(Rorippa nasturtium aquaticum)*

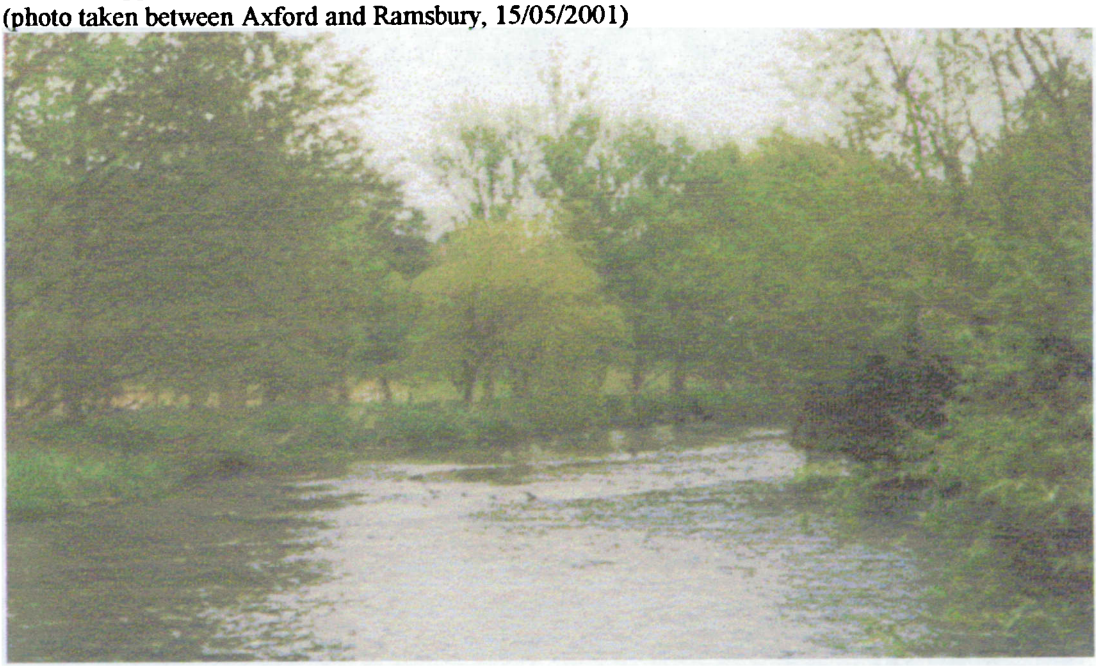
Source: adapted from Mainstone, 1999

The Upper Kennet's geomorphology adopts an anastomosing form (multiple branches) downstream of Marlborough (see EA, 1999; and EA, 2000e). This is characterised by lateral immobility and low rates of bank erosion, meaning that few sediment storage units are evident (EA, 2000e: 14), and shallow glides dominate (49.8%) over features such as pools and riffles (2.2%, 5.2%) (Maddock, 1996: 23). Today the channel is straighter (shortened 20-25% between Marlborough and Knighton: EA, 1999: 56), steeper, deeper and wider than it was previously (EA, 1999: 16).

UKRP's site characteristics. The UKRP which took place between 1999 and 2004 is located over several sites on a 10km stretch of the Upper Kennet between Mildenhall and Knighton (see Plate 4). This stretch is not homogeneous, as some reaches are degraded and almost canalised, whilst others exhibit classic chalk stream characteristics (De Garis *et al.*, 2001: 6) supporting predominantly *Ranunculus* beds. This rehabilitation project was conceived following a public inquiry in 1996 (Axford Inquiry), which investigated low flows on the upper river Kennet. TW appealed against the EA's decision to alter the terms of their existing abstraction licence base. TW's base licence entitled it to take up to 13.1 $Ml.d^{-1}$ which could be exceeded by 7.4 $Ml.d^{-1}$ subject to a minimum flow of 61.4 $Ml.d^{-1}$ (Calder, 1999: 164; and Ancram, 1998: 1). The EA decided to increase the minimum flow requirements, and to reduce TW's abstractions during periods of low flow, reasoning that low flows were damaging the Kennet, and that *Ranunculus* spp. and Brown trout – both indicators of a healthy chalk stream – were being diminished (Anon, 1999: 1). TW appealed against the EA's proposals, stating that changes to the Kennet's ecology were the result of both drought and changes in land management within the catchment (Ancram, 1998: 1; and Crafer, 2000: 75-76). Following the inquiry in 1998, the Environment Secretary acknowledged that the Kennet's ecology could be protected under low flows and raised the flow constraint to 90 $Ml.d^{-1}$, but he did not endorse the licence conditions proposed by the EA.

Reason for restoring the UKRP. During the Axford inquiry TW stated that if they won then they would use the money saved to make physical improvements (through rehabilitation) to the river in gratitude for being allowed to continue abstracting water (Nigel Holmes, Interview, 24/04/2001). Having said this TW argued that the poor condition of the Kennet was also caused by past land management practices (Nick Lutt, Personal communication, the river in gratitude for being allowed to continue abstracting water (Nigel Holmes, Interview, 24/04/2001). Having said this TW argued that the poor condition of the Kennet was also caused by past land management practices (Nick Lutt, Personal communication, 06/09/2002). Thus, in 1999, TW embarked on the UKRP in an attempt to redress damage caused by past management techniques and to restore relations with the local community for whom, according to Yvette De Garis (Interview, 18/07/2001) 'the abstractor was seen as the 'bad man' in the pack.' TW also wished to explore the use of soft river restoration techniques in improving a river's condition. The UKRP involved a five-year (1999-2004), three-phased programme of rehabilitation over a 10km reach, undertaken through means of a public-private partnership approach, reflecting the fact that no single organisation had the necessary expertise to fully deliver such a multidisciplinary project. The main aims of the project were to restore flows and habitat diversity, repair connectivity between the degraded and pristine reaches, benefit fisheries, contribute to local BAP and UK Chalk Stream Action Plan (EU Habitats Directive), and ameliorate a valued community asset.

Plate 4. Upper River Kennet, mown banks and wide uniform flow typical of fisheries management (photo taken between Axford and Ramsbury, 15/05/2001)



5.4.4 Summary

This section, which aimed to introduce in more detail the characteristics of the case studies, has shown that the projects differ significantly from each other. The main differences are in:

- The physical and environmental characteristics of the three catchments and reaches;
- The causes of environmental degradation of the three catchments and reaches; and
- The reasons for undertaking river restoration.

5.5 Decision-making structures

The characteristics of the decision-making structures employed on the case study projects were not fully detailed and readily available in the project archives. Instead they were reconstructed as part of the research using in-depth interviews with decision makers and the analysis of archival material such as memos, minutes of meetings and reports obtained from the archives of the EA Thames Region or the RRC. From this evidence it was possible to elucidate what roles individuals played in making decisions, and the power of these individuals' roles. From this analysis it was also possible to construct diagrammatic representations of decision-making structures for each project (Figures 21-23). These diagrams are used in Chapter 7 to evaluate the influence of different types of decision making on the structure of project appraisals. What is immediately apparent in what follows in this chapter is the extremely varied nature of the three decision-making structures. Since there is no overarching body overseeing river restoration each project has been structured differently. This has enabled flexibility of response to specific project characteristics, but also makes the sharing of best practice across projects much more difficult.

5.5.1 The Queen's Mead Recreation Ground project decision-making structure

(i) Decision-making teams and structures

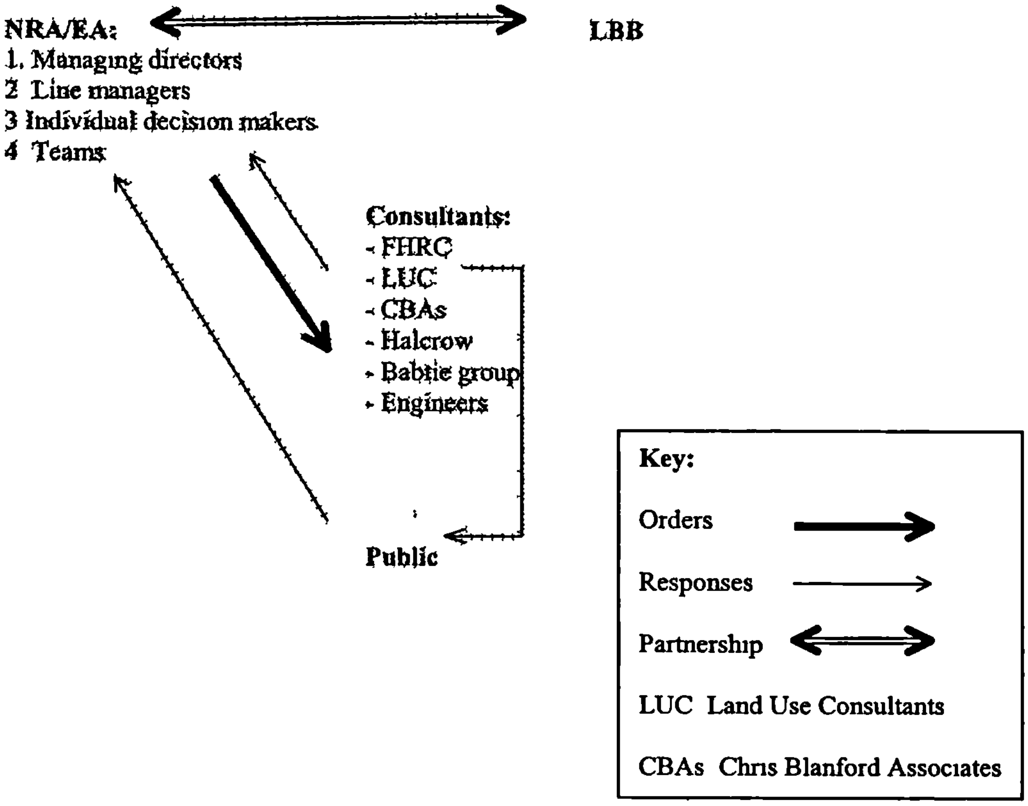
A complete list of all people involved in the Queen's Mead project, their job titles at their time of involvement, and the duration of their stay on this project is detailed in Appendix J. Although numerous people were involved in this project, the focus here is on the three main institutions (NRA, London Borough of Bromley and FHRC) which played key decision-making roles within the decision-making structure. The main people involved in this project and interviewed for this case study are listed in Table 34. Their responses are focused on in the most depth in the following section.

Table 34. The key people involved in the QMRG project

	Role during the project	Duration
NRA Study Review Team:		
Adrian Meadley	Project Manager, Engineering Services	1994-1998
Andy Pepper	Project Engineering Services (PES)	1994-1995
Richard Copas	Regional Landscape Architect	From 1989+
Kevin Patrick	Landscape Architect, Project manager	1994-1998
Trevor Odell	Flood defence officer	1998+
London Borough of Bromley:		
6. Christine Cranfield	Project Officer	1998+
Flood Hazard Research Centre:		
Maureen Fordham	Manager of research centre	1991-1992
Sue Tapsell	Research fellow	1991-1992
Sylvia Tunstall	Associate research manager	1991-1992

The decision-making structure for the QMRG project can be seen in Figure 21 Although the NRA and London Borough of Bromley were partners, the NRA was involved with the project in greater depth and over a longer period of time than London Borough of Bromley, providing the lead with designs and proposals. The London Borough of Bromley, while continually involved, played a secondary role by feeding ideas through to the NRA

Figure 21. The decision-making structure for the QMRG



(ii) Decision makers

The NRA primary decision maker As the primary decision maker in this structure the NRA continually interacted with the other groups (London Borough of Bromley, the consultants and the public) which were feeding ideas into the project's design over time Interaction with London Borough of Bromley (*secondary decision maker*) was necessary as London Borough of Bromley could veto any decisions or changes made to the project. Adrian Meadley (NRA's project manager) played an important negotiating role in this project

> 'So our role was really to make sure that all things were taken on board, rewriting the brief for the consulting engineers my role was to amalgamate all these things seeing that they were dealt with and of course to discuss with London Borough of Bromley exactly what they wanted us to do . So for me I had to sort of take it from the conceptual stage right through to construction' (Adrian Meadley, Interview, 20/04/2001)

The NRA's relationship with consultants differed from its relationship with London Borough of Bromley, as interaction with the former only occurred when specific elements of the project needed to be designed or appraised Similarly, interaction between the NRA and the public only occurred on two occasions The first occasion was undertaken indirectly through the FHRC who were commissioned to undertake the public perception work which yielded public approval of the concept of 'restoration ' The second, and the only direct contact the NRA had with the public, occurred during a public meeting following the creation of the project's 'vision ' The purpose of appraising public opinion in both instances was not to gain their input into project design, but to gain consensus for the restoration project to go ahead and to gain their approval for the pre-designed vision plan

Consultants tertiary decision makers Consultancies were employed by the NRA on short-term contracts with one-off input into project design and decision making For example, in 1992 a river landscape assessment of the catchment was undertaken by Land Use Consultants In 1994 Chris Blanford Associates were commissioned to undertake a feasibility study, which was then hydrologically appraised by Andy Pepper from the NRA's Project Engineering Services According to Maureen Fordham (Interview, 31/01/2001), the role of these consultants was peripheral to that of the NRA because they did not have any powers of influence outside of the work they were contracted to undertake So although consultants could and did have decisive input into this project, it was only NRA representatives who had the power to implement ideas or alter the project's trajectory

Internal decision makers During his quest to gain funding for this project, Kevin Patrick found evidence of an internal decision-making hierarchy operating within the NRA (see Figure 21) Within this internal hierarchy Kevin Patrick had less power to promote the scheme than people higher up in the NRA who were responsible for the allocation of funds

> 'One constraint was that it is difficult to know which levers to pull in an organisation such as the EA How do you get a project like this – that everyone wants to see happen – actually off the ground? It seemed to be a lot about who you knew'(Kevin Patrick, Interview, 12/12/2000)

The project's appraisal and implementation was ultimately managed by people at the top level in the NRA Thames Region whose control of the purse strings meant they had the casting vote on which projects were implemented So, although the NRA was placed at the top of the decision-making structure, the power of those NRA members directly involved in the project (e g Adrian Meadley and Kevin Patrick) was dependent upon the power exerted by those at more senior managerial levels

5.5.2 The Cole River Restoration project decision-making structure

(i) Decision-making teams and structures

A complete list of all the people involved in the Cole project, their job titles at their time of involvement, and the duration of their stay on this project are detailed in Appendices K and L Although a range of individuals were involved in this project, this research focuses on those who played managerial or long-term roles in the project's decision-making structure. The main people involved in this project are listed in Table 35. All those listed were interviewed for this case study save those whose names are crossed-out Those crossed-out either did not respond to the researcher's request for an interview or were unable to be interviewed for various reasons

Table 35. The key people involved in the CRRP project

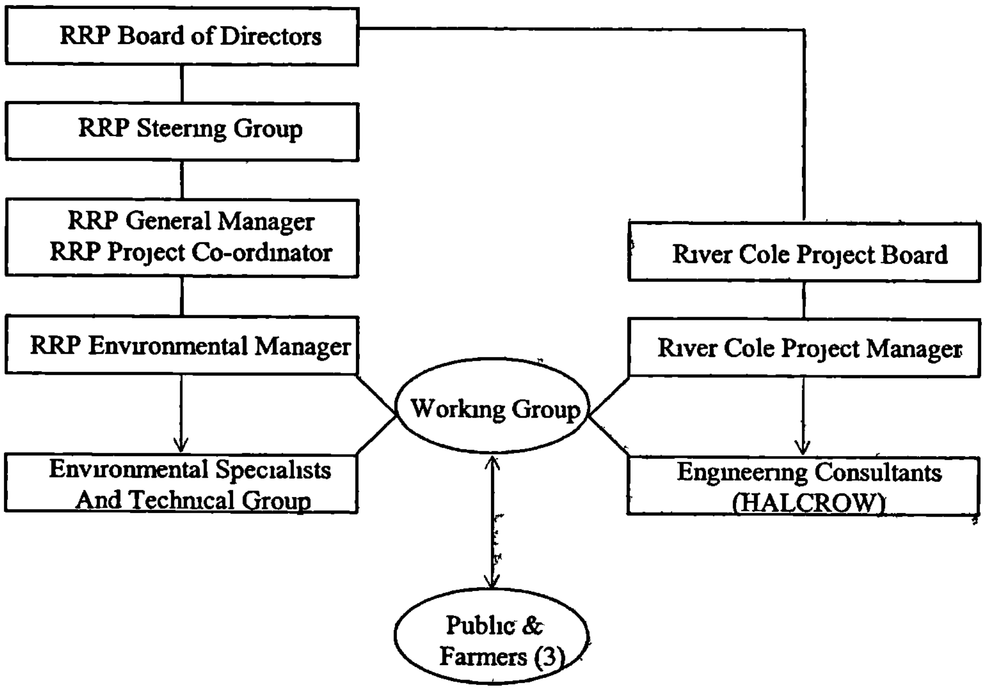
	Role
RRP Board:	
Nigel Holmes (Alconbury Environmental Consultants)	Chairman of RRP
David Sear (Southampton University)	Geomorphologist
RRP Officers:	
Jeremy Biggs Environmental Manager (Ponds Conservation Trust)	Freshwater Biologist
Martin Janes Project co-ordinator (RRC)	Centre Managers
Richard Vivash General Manager (Riverscape Consultancy)	Civil Engineer
RRP technical group:	
Alastair Driver (EATR)	Conservation Manager
~~Andrew Brookes (EATR)~~	Geomorphologist
Cole Project Board:	
Nigel Holmes (Alconbury Environmental Consultants)	Chairman of RRP
Richard Morris (NT)	Estates Manager
Cole Working Group:	
Keith Blaxhall (NT)	Senior Warden
~~Andrew Brookes (EA, Thames region)~~	Geomorphologist
Richard Copas (EA, Thames region)	Landscape Architect
Alastair Driver (EA, Thames region)	Conservation Manager
Karen Fisher (Hydraulics Research Wallingford)	Projects Engineer
Richard Morris (NT)	Estates Manager
~~Colin Platt (EA, Thames region)~~	Project Manager
David Sear (Southampton University)	Geomorphologist
Consultants:	
Sylvia Tunstall (FHRC- Associate research manager)	Public perception work
Sue Tapsell (FHRC- Research fellow)	Public perception work
HALCROW	Engineering consultants

Decision making on the CRRP was undertaken by two distinct groups (see Figure 22) The *RRP management group* (see Appendix K) which was created when RRP was founded, with members linked to one or both of the Cole and Skerne projects, and the *CRRP management group* (see Appendix L) which focused specifically on the Cole project Some key decision makers were involved simultaneously in both groups (see arrows, Table 35) A complex decision-making structure was needed, and was specified at the outset of this project in order to ensure success and also to gain support (financial and statutory) from the NRA As project partner, the NRA would not confirm their support until a project management and project board structure was established and legal agreements regarding liabilities drawn up

(Holmes and Nielsen, 1998 187-188) Hence the decision-making structure seen in Figure 22 was established, and a Memorandum of Understanding was signed by all UK participants, who agreed to work together to resolve any problems (Holmes and Nielsen, 1998 192-193) Though both groups (RRP and CRRP management groups) were involved in project appraisal, the CRRP group played the greatest role as it was devoted solely to the project's planning and execution

Figure 22. The decision-making structure for the CRRP, including management structures

RRP management group **CRRP management group**



Source adapted from Holmes and Nielsen, 1998 192, and Cole Project board archives, 16/09/1994

(ii) Decision makers

RRP management group The structure of the RRP management group can be seen in Figure 22 Within this management structure ultimate legal responsibility for RRP lay with the board of directors (non-EA members) The RRP board was composed of Nigel Holmes (part-time managing director), Richard Vivash (director of projects), and Martin Janes (centre co-ordinator) who ran, and continues to run, day-to-day activities within the centre All staff reported to, and were steered by, directors of RRP and senior representatives from some of the participating organisations (see RRC, 2002b). The steering group was made up of individuals interested in the management of floodplains and/or rivers. The technical group was composed of people involved in setting up RRP, who due to institutional links to the EA could not become the director of another company but could become involved in project appraisal and design (Martin Janes, Interview, 08/05/2001)

CRRP management group The CRRP management group was composed of sub-groups (see Figure 22) project managed by Colin Platt (NRA), with input from a working group whose members were selected to cover all functions of the NRA (e g geomorphology, hydrology, ecology, conservation, fisheries, heritage, planning and public consultation) with area and regional representatives NRA working group members helped RRP select other suitable non-NRA members (e g Hydraulics Research, Wallingford), ensuring a broad range of disciplines and organisations were involved in the appraisal process (e g statutory bodies, consultancies and universities) Suggestions made at working group meetings had to be appraised and agreed upon at project board meetings, which formed the highest level of the CRRP management structure, and was composed of representatives from organisations who had the authority to decide the fate of the working group's plan For example, the EA (as statutory body) and the National Trust (as landowner) appraised all ideas and plans with final say on what went ahead (Holmes and Nielsen, 1998 191)

Individual decision makers From these two management groups, the insight and vision of certain key individuals played an important role in the appraisal process In particular, Colin Platt acted as an intermediary between the project board and the working group Through him ideas were fed and drawn together into 'something that worked' (Martin Janes, Interview, 08/05/2001) Martin Janes was also involved in both management groups, enabling him to gain an intimate knowledge of the project which was invaluable during on-site supervision of engineering contractors, as he was able to make *in situ* appraisals, facilitating changes to the project as it evolved (Vivash *et al*, 1998 205) Richard Morris (National Trust's property manager) was also a member of both groups, and played a central role in the decision-making process, acting as the voice of the National Trust and its three tenant farmers, with whom he negotiated closely Representing the National Trust, Richard had the final say on all aspects of the project, as 'The Trust could not sanction anything which they were not happy with' (Richard Morris, Interview, 17/05/2001) For example, the National Trust specified that the project could only go ahead if the farmers were included Nigel Holmes, Jeremy Biggs and Richard Vivash also played vital roles on both management committees into which they fed their ideas and experiences As general manager Richard Vivash's role was to

> 'Bring the whole project together and to deliver it And that really involved bringing all my experience to bear That was also against a background team of specialists So I was really the focal point around which all the other things could be brought together' (Richard Vivash, Interview, 13/03/2001)

David Sear and Andrew Brookes provided important geomorphological input through their memberships of the project board, technical group and the working group An unconventional approach to consultancy also strongly influenced the CRRP's appraisal Whereas engineering firms usually provide project designs (e g channel cross-sections), on the CRRP plans were drawn-up by the project board and working group and provided to the engineers (Halcrow) (Martin Janes, Interview, 08/05/2001) The purpose of this was to ensure that the restored river was designed holistically with environmental criteria in mind rather than being based on engineering principles, which had in the past resulted in the creation of symmetrical channel cross-sections

5.5.3 The Upper Kennet Rehabilitation project decision-making structure

(i) Decision-making teams and structures

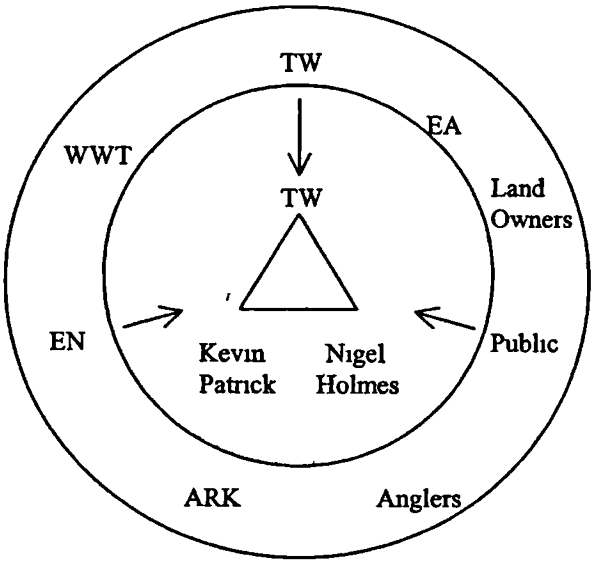
The main institutions involved in the UKRP were TW, EA, English Nature, Action for the River Kennet, Wiltshire Wildlife Trust and other local interest groups (see Table 36) Although numerous people were involved in this project, because it was on-going at the time of research some of the people involved were under severe time constraints and thus could not be interviewed As a result, the accounts of four key individuals (italicised in Table 36) were focused on during examination of the project's decision-making structure (see Figure 23) TW and two consultants (Nigel Holmes and Kevin Patrick) were central to this process, with all stakeholder groups engaged in the project feeding their ideas to them as part of a central decision-making triangle (through working group and steering group membership)

Table 36. The key people and organisations involved in the UKRP

	Role during the project
Thames Water (TW):	
Yvette De Garis	Project manager for TW
Mike Crafer	Conservation manager
Andy Tagg	Hydrological input
Nick Lutt	Environmental Scientist
Consultants:	
Nigel Holmes (Alconbury Environmental consultants)	Project director
Kevin Patrick (Hankinson and Ducketts Associates)	Project manager
Richard Vivash (Riverscapes consultancy)	Feasibility study
Partners:	
EA, English Nature, Wiltshire Wildlife Trust, RSPB, Action for the River Kennet, Land owners, and Local Community (parish council, schools and anglers)	Consultees

TW led the UKRP and, as the project's main funder, all decisions had to be first cleared through them (hence their location at centre of Figure 23) As consultants commissioned by TW, Kevin Patrick (project manager for entire project, Hankinson and Ducketts Associates) and Nigel Holmes (project director, Alconbury Environmental Consultants) were also central to the decision-making circle, yet because they were answerable to TW they are located at the base of the central decision-making triangle The consultants consolidated this public-private partnership approach, drawing in the technical expertise and collaborating with the other project partners who formed part of either a steering group or working group The steering group was composed of EA, English Nature and Action for the River Kennet (as the key stakeholders) This group was involved in making decisions about which projects should be adopted and how budgets should be allocated During steering group meetings the members voted on which projects should be implemented through use of a scoring matrix The working group was larger than the steering group as all organisations (see Table 36) were invited to form part of it, including steering group members and specialists from specific fields (e g fisheries and hydrology experts from within the EA) The role of the working group was 'to come forward with designs and technical ideas, advising the project manager through surveys and background information' (Mike Crafer, Interview, 18/07/2001) A partnership approach was imperative for project success on the UKRP as it was undertaken on privately-owned land and could not go ahead without consent of the landowners

Figure 23. The decision-making structure for the UKRP



Key:
ARK Action for River Kennet
EA Environment Agency
EN English Nature
TW Thames Water
WWT Wiltshire Wildlife Trust

(ii) Decision makers

TW (project leader) As project leader and main funder, TW had a lot of influence and the final say on the direction this project took Internally, Yvette De Garis project managed the TW team, ensuring that work was on schedule and could be completed within the given budget and time frame As TW's conservation manager, and the expert ecological witness at the Axford inquiry, Mike Crafer provided support to the project manager and also technical support on the ecological side TW contracted out the roles of project director and project manager, employing

Nigel Holmes and Kevin Patrick Located at the centre of the decision-making circle, TW were very influential as the initiators of the project and also as the prime funders Although TW's power gave them freedom to pull out of the project at any time, this was not in their best interests as the Axford inquiry had not been a good PR exercise for them A collaborative public-private partnership approach was important for TW in repairing damaged community relations and ensuring that all stakeholders (riparian owners and local angling groups) had input into the project's appraisal This approach also made practical sense because TW 'did not have a monopoly on ideas or a singular vision for the project' (Mike Crafer, Interview, 18/07/2001) Thus, although TW were central in the decision-making circle, an egalitarian approach to decision making and appraisal was selected due to political fragility and the need for legitimisation

Environmental consultants As consultants, Nigel Holmes and Kevin Patrick had very important roles within this project since they negotiated with all the stakeholders, and were hence placed at the centre of the decision-making circle, albeit in a role subordinate to TW The consultants spearheaded the collaboration between the private and public partners, by eliciting personal contact with all stakeholders via working group and steering group meetings, site visits (they both walked the 10km rehabilitation reach), and informal discussions with landowners and river keepers This enabled all partners to feed ideas and concerns into the design process, becoming actively involved in the project's appraisal Nigel Holmes' role, as project director, was specifically to provide the vision and design ideas for the rehabilitation options His reputation also helped generate a sense of trust amongst landowners (Mike Crafer, Interview, 18/07/2001) with whom he discussed ideas for the project's design and took on board their local knowledge of the river Mike Crafer re-emphasised the importance of a trusted figure when he stated

> 'The other thing I learnt was the importance of engaging the landowners very early on, particularly through somebody they trust, like Nigel Holmes, who can explain the benefits of the project to them in a very visual and graphic sense' (Mike Crafer, Interview, 18/07/2001)

Kevin Patrick, in his role as project manager, co-ordinated the day-to-day running of the project, helping deliver practical work on the ground via contractors. Having developed a comprehensive and viable project plan, he ensured this was kept up to date and was undertaken within specific time and cost constraints In the decision-making circle, the consultants acted as the link between TW and project partners whilst also influencing the project's appraisal through its design and implementation TW's environment and quality team were also in regular and direct contact with the EA, English Nature and Action for the River Kennet, reflecting the division of expertise between individuals on the team

Steering groups and working groups Through working group and steering group meetings, the consultants were able to actively involve all partners in the project's appraisal, with the working group coming forward with technical ideas, and the steering group having the final say on proposals prior to implementation The impartiality of Kevin Patrick and Nigel Holmes enabled them to play central roles in drawing together ideas and getting people to agree on which rehabilitation options to adopt They then fed the ideas and decisions made by these two groups into the central decision-making triangle where final consensus was reached in a democratic manner by all decision makers Although the working group provided the consultants with survey data and background information, the designs for the rehabilitation options were drawn up by the consultants as opposed to the stakeholder groups. The landowners were allowed to comment on the options before they were put forward for selection at steering group meetings (Nigel Holmes, Interview, 24/04/2001) During these meetings the consultants did not recommend which projects should be undertaken, instead they offered a series of options for different sites, on which the steering group then voted (Nigel Holmes, Interview, 24/04/2001) This democratic approach to rehabilitation option selection ensured that sites were selected first appraised by landowners then the steering group, rather than solely by the consultants and TW

Partnerships On the UKRP, partnership formation was deemed to be of key importance because after the Axford inquiry all partners 'were daggers drawn' (Mike Crafer, Interview, 18/07/2001) This project enabled the development of trust and communication between the partners, bringing together the main protagonists from the inquiry This approach was also beneficial to the project's appraisal as it incorporated stakeholders' expectations (Patrick, 2001· 7), ensuring that landowners came on board at an early stage via the demonstration project This approach help develop partnership ties and also, according to De Garis *et al* (2001 6), it enabled issues to be raised and design modifications to be made at an early stage

5.6 Conclusion

This chapter has discussed the three selected river restoration case studies within the context of the Thames region It was seen that all three projects exhibited different characteristics in terms of their physical location, reasons for restoration and those institutions, individuals and groups involved in river restoration At the beginning of this chapter it was proposed that decision-making structures need to possess the following three qualities

- Effectiveness - to make and implement decisions,
- Inclusiveness - to involve all those who should be involved, and
- Legitimateness - to secure consensus on their decisions

Building on these ideas, Section 5 5 examined in detail how decision making was undertaken on the three case studies It has shown that the decision-making structures adopted differed greatly due to the variety of institutions and agencies involved, the variety of reasons for restoration and because no set formula exists on how decision making is undertaken on river restoration projects It was also seen that each project must construct a workable structure within which stakeholders can come together to agree the project's design In each case this has implications for the balance struck between the three qualities outlined above, and for the potential roles of science and public participation in these projects

On the Queen's Mead project, decision-making was undertaken within a hierarchical structure The NRA was located at the top of this structure with the strongest powers of influence on the project's overall trajectory Other groups which had one-off involvement in the project (such as consultants and the public) were located lower down the structure These groups had less power to influence the project than the NRA This decision-making structure is from hereon referred to as a *hierarchical decision-making structure* Hierarchical structures are capable of being effective as they can enable decisions to be made and implemented rapidly However, these structures have the potential to be undemocratic and hence not inclusive as they can facilitate decision-making solely by 'experts' or those with the greatest power This risks reducing the legitimacy of the decision-making process as decisions are reached undemocratically leaving certain voices unheard

By contrast, on the Cole project, decision making was complicated by the existence of two separate yet interacting managerial groups This bilateral mode of decision-making (referred from hereon as a *bilateral decision-making structure*) developed to ensure that all decisions made on this project fitted with the RRP's wider institutional goals as well as the site's specific goals in its role as an EU Life demonstration project Bilateral structures can be inclusive in that they enable a wide range of individuals to become engaged in the making of legitimate decisions However, if the two decision-making groups were composed of solely experts then inclusiveness would be reduced as a wide spectrum of stakeholders' opinions would not be appraised, and the results of the decision-making process would therefore not be representative of all expert and non-expert opinion

On the upper Kennet, the project's politicised beginnings meant that decision making had to adopt a partnership approach (referred to as a *partnership-based decision-making structure*) This approach was also adopted because TW believed that no single organisation had all the necessary expertise to deliver a project of this size, or to deliver such a multidisciplinary project Partnership-based approaches to decision-making can be both inclusive and effective, as they can facilitate democratic decision making and a more equitable balance between scientific and lay knowledges, whilst also enabling decisions to be rapidly implemented Having said this, whilst a wider range of stakeholders can become involved in this decision-making structure ultimately the final decisions are still made by expert decision maker This can reduce the legitimacy of the decision-making process as complete control of the project is not conferred to all stakeholders

The three case studies described were seen to differ greatly in terms of their of their physical and environmental characteristics, the causes of environmental degradation and the reasons for undertaking river restoration (Section 5 4) These three very different case studies unsurprisingly possessed very different decision-making structures (Section 5 5) As can be seen in the discussion above each of the three structures achieved a different balance between the three criteria which were proposed as necessary components of a decision-making structure The structures utilised all enabled decisions to be made but in different ways with different implications The following chapter examines the different appraisal structures employed on these projects The differences between the appraisal structures and techniques proposed in the literature and those utilised in practice are examined In Chapter 7 the impacts of decision-making structures on appraisal structures and *vice versa* are evaluated This evaluation will help to ascertain the overall effects of these structures on a project's trajectory and final implementation

Chapter 6. Thames Region Investigation: evaluating river restoration appraisal structures

6.1 Introduction

In Chapter 4 it was demonstrated that although 233 UK river restoration projects claimed to have undertaken an appraisal, the depth of these appraisals was often limited to anecdotal professional judgement or subjective visual techniques such as photography Despite the rarity of detailed project appraisals, some projects have been designed and executed within rigorously structured appraisal frameworks The purpose of this chapter is to describe three such frameworks employed on the rivers Ravensbourne, Cole and Kennet (Section 6 2) By concentrating on a few selected cases this chapter provides a much greater depth of qualitative detail on the design of appraisal structures than was possible in the purely quantitative national investigation

In Chapter 2 an idealised appraisal framework was outlined This framework was divided into a series of three phases and ten steps (see Figure 6) The first phase provided a series of steps to help select a site, define aims and objectives for a project and facilitate the collection of pre-project baseline data The second phase of the framework related to the design and construction of the project The final phase enabled the post-project appraisal of the project against the aims and objectives and baseline data collected in the first phase The purpose of these steps is to act as a checklist to ensure that adequate data are collected at the pre-project stage, facilitating a holistically-designed project whilst also enabling post-project appraisal to be undertaken The appraisal structures described in this chapter are evaluated against this proposed model of appraisal It was argued in Chapter 2 that a clearly and logically structured appraisal framework ensures that all components of a project are considered at the outset, circumventing project delays at later stages and ensuring a project's successful implementation The framework proposed in Chapter 2 is returned to in Chapter 8 where its practical applicability is further evaluated

Section 6 2 first describes the three appraisal structures employed on the case studies This is followed (Section 6 3) by an evaluation of the appraisal structures employed against the specific components of the appraisal framework which was proposed in Chapter 2 In Section 6 4 the specific appraisal techniques which were employed on the three case studies are also evaluated, focusing on their consideration of the catchment context and specifically evaluating the geomorphological and public appraisal techniques employed The analysis of the appraisal techniques focuses on the depth and breadth of the techniques employed For example, whether site selection techniques and geomorphological techniques are nested within the catchment context, how much baseline data were collected, and the extent of public involvement in the appraisal process Overall, this chapter aims to highlight the differences between the appraisal frameworks employed in the case studies and the differences between these appraisal frameworks and the framework proposed in Chapter 2 Chapter 7 then provides a link between the decision-making structures discussed in the previous chapter and the appraisal structures analysed here This chapter concludes that like the decision-making structures discussed in the previous chapter, the appraisal structures employed on the three case studies differed substantially in terms of their structure Furthermore, when compared to the appraisal structures and techniques proposed in the literature in Chapter 2 it was shown that the appraisal techniques utilised favoured subjective as opposed to objective approaches to site selection and goal development Also geomorphological-, public- and post-project appraisal could have been undertaken with greater breadth and depth on all sites However, site specific constraints, and the influence of different decision makers and their disciplinary backgrounds affected the trajectory of each project's appraisal

6.2 Appraisal structures

It has been seen in Chapter 5 that the three case-study projects differed significantly in terms of their decision-making structures The following section describes the different appraisal structures and techniques employed on these case studies This section also documents the different histories of each case study, enabling an understanding of how the projects emerged, and highlighting the complexities of each case study's appraisal structure and the factors which constrained and shaped the projects This section is largely descriptive, and is purpose is three-fold Firstly, it provides accounts of the historical development of the case studies enabling the reader to understand the structure of each project's appraisal Secondly, it provides the context for Section 6 3, whereby these appraisal structures are evaluated against the framework proposed in Chapter 2 Thirdly, the appraisal structures described here are returned to in Chapter 7 when the relationships between decision-making structures and appraisal structures are evaluated

As with the decision-making structures, appraisal structures employed on the case studies were not detailed in project archives Instead, they were reconstructed by the researcher following in-depth interviews with decision makers and analysis of archive material This material enabled a detailed picture of the different stages of appraisal to be built up, leading to the construction of timelines for each of the appraisals

Table 37. A timeline of the QMRG appraisal process

1989	Ecological assessment of the Ravensbourne catchment by London Wildlife Trust
1990	Geomorphological evaluation of the Queen's Mead site by Andrew Brookes
1991	Public perception work (FHRC)
1992	Ravensbourne catchment landscape assessment by Land Use Consultants
1994	£200K of grant-in-aid (GIA) money was gained to be spent within this financial year
May	Feasibility study by Chris Blanford Associates
July	Hydraulic investigation of feasibility study
	LBB formally adopted this scheme, agreeing to contribute £42K in 96/97
September	Public meeting undertaken
1995	Scheme aborted because the GIA funds were withdrawn
1996	
March	Hydrogeological investigation and modelling of four design options by Halcrow
April	Joint Millennium bid between LBB and the NRA agreed
1997	
January	Project put forward for a Millennium Marque grant, and accepted as being eligible
October	Millennium Marque bid turned out to be unsuccessful
	Agency agreed to investigate a more economically modest scheme
November	Scheme entered into evaluation matrix by NRA, it scored 24 points making it a high priority site
December	Scaled down design produced, estimated to cost £152,086 in total
1998	
March	Halcrow produced a Project Risk Register
June	Project delayed for another two years until revised scheme produced
2000+	Geomorphological assessment of the Ravensbourne by Babtie suggested sites in catchment for enhancement and will also be responsible for future geomorphological work

6.2.1 Queen's Mead Recreation Ground project: appraisal structure

The Queen's Mead project underwent a very comprehensive process of project appraisal (see Table 37) This section looks in detail at the structure of the appraisal, examining what was appraised and how this appraisal was undertaken In order to do this the trajectory of the QMRG project's appraisal is traced through a suite of five successive vision plans which have been created for the site 1 hypothetical vision, 2 real vision, 3 mitigation vision, 4 revised vision, and 5 final vision The creation of site vision plans (also referred to as *Leitbild*) is the usual point of departure for most river restoration projects (as seen in Chapter 2) A vision plan is usually composed of clear aims and objectives which need to be achieved in order to create this vision At Queen's Mead, because the project was initially hypothetical, the original vision plan for the site changed as the aims and objectives evolved throughout the project's duration

Site appraisal and identification The Queen's Mead site was first identified as a potential site for restoration in 1989 when appraisal of the Ravensbourne's ecology (by London Wildlife Trust) found 23km of the river to be of poor ecological quality (Babtie, 2000 6) This appraisal, and a later landscape assessment of the catchment (NRA, 1992a 3), justified the site's selection for restoration Shortly after this John Gardiner (NRA, Thames region) decided to use this site to trial a hypothetical river restoration project through appraisal of public perceptions

(i) The hypothetical vision

Appraisal of public perception Following the identification of the Queen's Mead site, hypothetical vision plans for three alternative river restoration options were drawn up by NRA landscape architects, with colour site plans providing a picture of what the project could look like The three restoration options included a) do nothing, b) partial restoration, and c) complete restoration (see Plates 5a-c) Public perception work undertaken by FHRC in 1991 appraised the public's views on these three design options Public approval of the project was necessary, as the local community stood to be the main beneficiaries of this project This public appraisal was undertaken by 14 interviewers, and involved three separate surveys

1 Park users'survey. 357 people were interviewed from 27th July to 8th September 1991 by two interviewers situated a) on the bridge in the recreation ground, and b) anywhere on St Martin's Hill with a view of the river Interviewer days were split between weekends and weekdays Interviewers interviewed the first person passing thus assuring random selection,
2 Local residents'survey 352 people interviewed from a half to a quarter of a mile away, and
3 Local school children's survey 20 Year 4 (8 year olds) pupils interviewed in a focus group for two hours (see Tapsell *et al*, 1992 6-7, Tapsell, 1995 106-108, and Tapsell, 1997. 46-47)

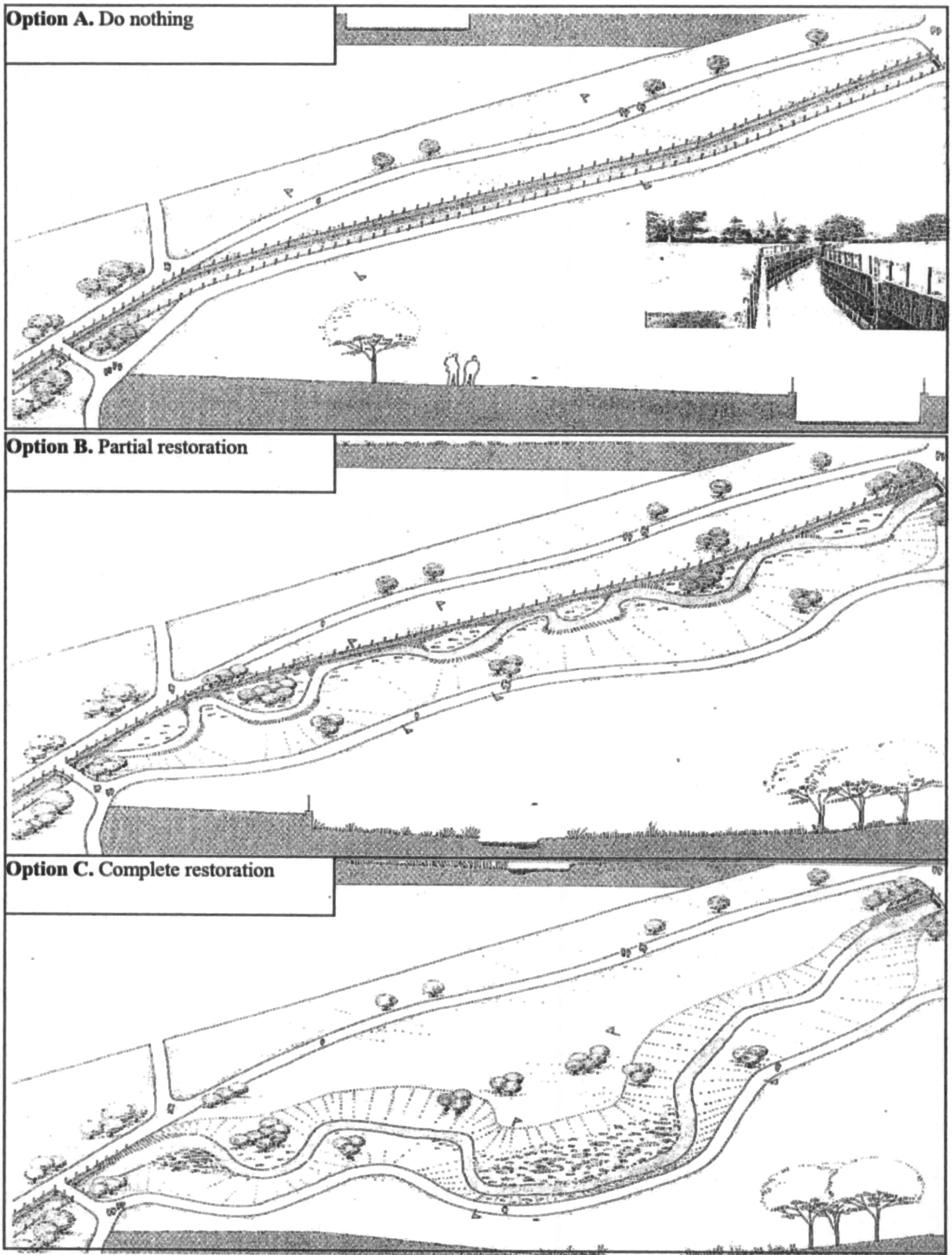
The public were shown the three plans and asked to select a preferred option for their park Strong public support for river restoration at the Queen's Mead site was witnessed in all three surveys, with option c selected by 80% of respondents as the most desired vision for the park. The usage of Plates 5a-c helped to put across technical concepts to a lay audience During this appraisal the high level of public support for option c meant that a decision was made for the project to progress from being 'hypothetical' to 'real '

(ii) The feasible vision

In 1994 the NRA commissioned Chris Blanford Associates to undertake a *feasibility study* to help make the 'hypothetical' vision plans 'feasible ' This feasible plan had to work within four objectives delineated by the NRA for this project·

1. *Geomorphological* Produce a self-adjusting, self-cleansing channel, which produces its own features such as pools and riffles without maintenance,
2 *Visual* Produce a dramatic and photogenic improvement in the visual quality of the river in the park by removal of concrete and steel surfaces and replacement by softer natural materials changing the river from its straightened form to a meandering course,
3 *Access* Enable public access to the water's edge This would only be achievable with assurance of no risk to the public's health and safety, and
4 *Vegetation* Produce a dramatic increase of in-channel and bankside plants including marginals, aquatics and a few trees (Ravensbourne project archives, EA, Thames region)

Plate 5 a-c. Hypothetical vision plans for QMRG restoration options a-c



Source: Tapsell *et al.*, 1992: Appendix 2-5

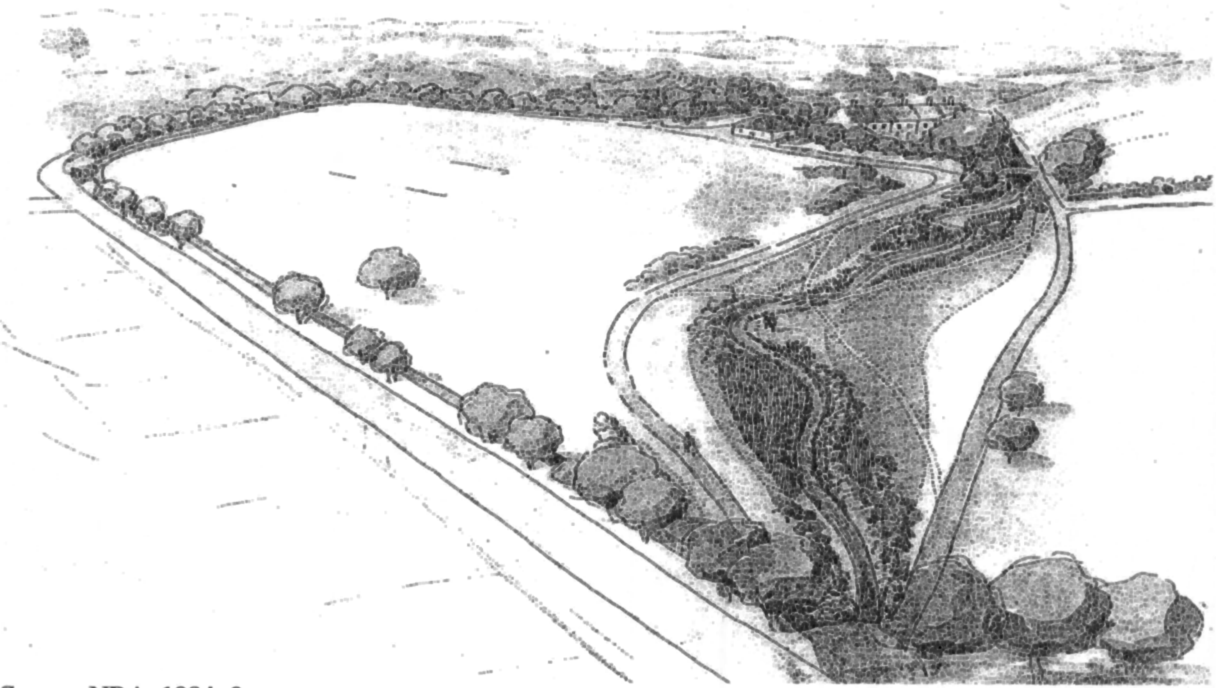
The end product of this feasibility study was a set of design drawings which had to be technically feasible in relation to all site constraints and fully costed As part of the feasibility study Chris Blanford Associates first identified the opportunities and constraints to the project (see Appendix M), and then compiled four options for channel treatment and four designs for the entire site Consultation with the NRA, London Borough of Bromley and TW led to the selection of site design 4a and channel treatment option 3 (see Plates 6-7) at a cost of £290,000 This channel treatment option retained the existing channel in a culvert to carry storm water, with a promenade built over the top of the old channel To the south of this existing channel, a new naturalistic channel would be constructed to carry normal flows diverted from the culverted channel (see NRA, 1994) based on the 1863 meander pattern A v-notch weir would allow storm water to flow through into the new channel and during periods of flooding the water could flow down the old channel Channel heterogeneity would be achieved by varying the bed profile, including pools, riffles, beaches and reed beds Ecological features would include trees, shrubs and native herb mixes Landscaping would allow public access to the new channel through a public walkway, a viewing platform, grass terraces and a flood bund This feasibility phase of the project's appraisal built onto concepts developed during the hypothetical vision, but entered into greater depth and technical complexity Once the final feasible design was completed, Chris Blanford Associates recommended that the designs be subject to a hydrological appraisal and a public appraisal prior to their implementation

During the *hydrological appraisal*, however, the NRA's Project Engineering Services found that Chris Blanford Associates' new designs would lead to a risk of basement flooding in properties adjacent to QMRG However, by the time that this flood risk was realised a meeting had already taken place between London Borough of Bromley and the NRA, drawing up the parameters of a joint project and setting a date for public consultation (NRA Thames region archives) Furthermore, at this point London Borough of Bromley had formally adopted the scheme and agreed to contribute £42k towards the cost Following the realisation of the project's associated flood risks, a public meeting was arranged jointly by the NRA and London Borough of Bromley The primary purpose of this meeting was not to discuss flooding (as grant-in-aid funds had been secured for the project to be undertaken that year) but to discuss preferred restoration design options

The *public appraisal* took the form of a public meeting which was attended by 60 people According to the FHRC's Maureen Fordham (Interview, 31/01/2001) who was undertaking the public appraisal, the NRA decided to

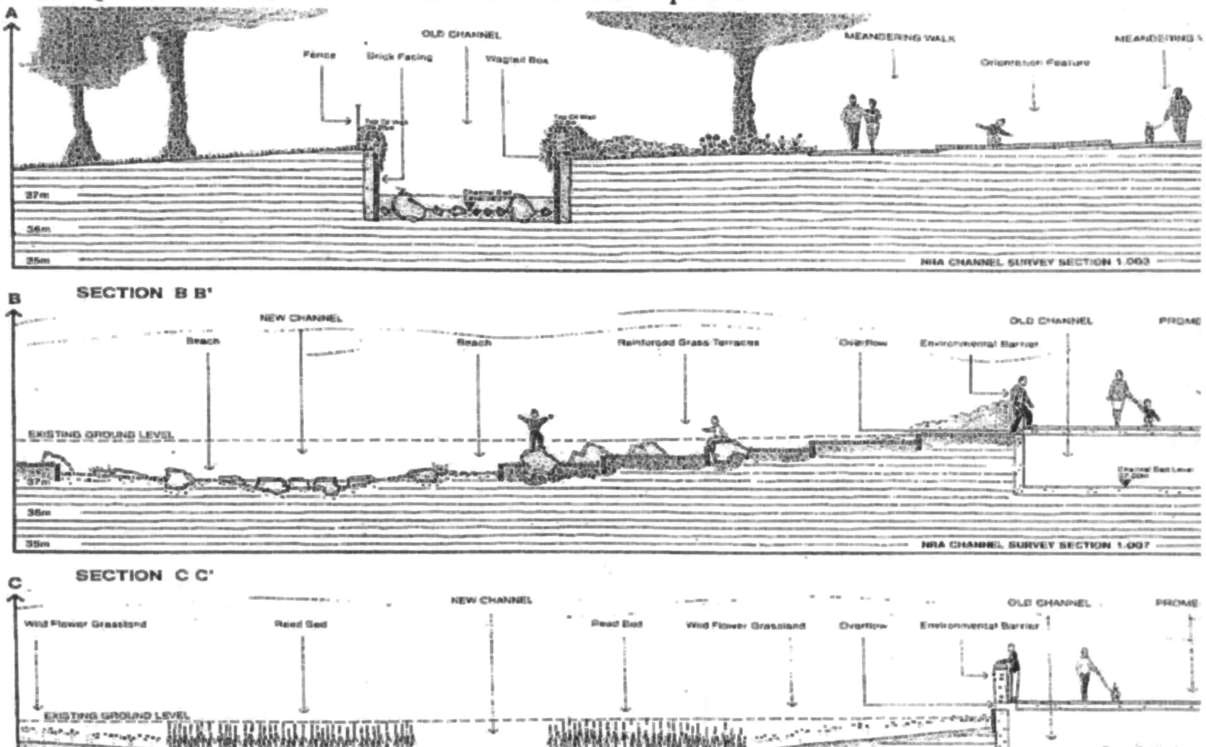
> 'Engineer-out public debate (through use of visual presentations rather than a question and answer session) because most people who were involved in it had a clear understanding of how awful public meetings are, and how threatening they can be (to the organisers) '

Plate 6. Queen's Mead Recreation Ground site design 4a



Source: NRA, 1994: 9

Plate 7. Queen's Mead Recreation Ground channel treatment option 3



Source: NRA, 1994: 6

At this meeting only a small proportion of those who stood to be affected by the project were present, and an even smaller proportion of the local population answered a questionnaire circulated by the NRA (24 people) to gauge people's opinions of the project From this meeting and this questionnaire it was found that only 15 people were in favour of the scheme, five were in favour but made some suggestions, and four were against the scheme for various reasons (see Appendix N) Public evidence played an important role in supporting Andy Pepper from the NRA's Project Engineering Services' evidence that the project if undertaken could increase flood risk This resulted in adecision being made to stall the project instead of submitting it for tendering in 1995 (see Appendix O) In early 1995 a final blow was dealt to the project, as previously secured grant-in-aid funds were withdrawn Despite this decision to stall the project the NRA decided to enter it for a joint Millennium Marque bid in order to proceed with the project subject to design revisions

In 1996 Halcrow (engineering consultants) were commissioned by the NRA to undertake a thorough *hydrogeological appraisal* of the Queen's Mead site The purpose of this investigation was to further appraise Project Engineering Services' findings, whilst also identifying potential options to mitigate flood risk (see Phipps and Croxford, 1996) Halcrow's investigation took place in three stages (as seen in Table 38a), and examined the four restoration options proposed in the 1994 feasibility study (Table 38b)

Table 38. Three stages of hydrogeological investigation and four restoration options for the QMRG

A. Stages of investigation:	
Stage 1 Site works programme	Determine site's hydrology, geology, groundwater occurrence, aquifer parameters, hydraulic relationships and groundwater flow
Stage 2 Impact assessment	Modelling of different restoration options, impact modelling, and assessment of risk
Stage 3 Mitigation options	Analysis of basement flood mitigation options A-D
B. Restoration options:	
Option A	Cut-off wall through alluvial gravel beneath 1 in 100 year flood bund
Option B	Raise 1 in 10 year flood bund to be capable of retaining 1 in 100 year flood
Option C	Lining of river channel with impermeable material
Option D	Lining 1 in 10 year flood plain with impermeable material

Source adapted from Phipps and Croxford, 1996 i-iii

Through excavation of boreholes (Stage 1 site works programme), geological and hydrological information was then used (Stage 2 impact assessment) to model restoration options A-D, and to simulate 1 in 10 and 1 in 100 year flood events, modelling their likely risk. Modelling confirmed the suspicion that the main impact of flooding would be to the basements of adjacent housing, and for all four options a 1-in-10 and a 1-in-100 year flood event would cause a 0 2m and 0 4m basement flood respectively These findings meant that this second vision for the site needed to be re-appraised and a mitigation plan devised (Stage 3) so that restoration could be undertaken without causing increased flood risk. The level of feasibility for options A-D was modelled The 'Naturalised' unlined options A and B were not deemed possible, as they would cause basement flooding However, options C and D combined with B were found to be the best options for mitigating basement flooding and enabling restoration to proceed This led to the creation of a third vision plan

(iii) The revised vision

Halcrow's hydrogeological appraisal influenced the project's design trajectory, as it reiterated the NRA's Project Engineering Services' and residents' concerns about flood risk and led to the creation of revised designs to enable the project to go ahead in the future by mitigating flood risk. However, these proposed design revisions substantially increased the cost of the project, as mitigating basement flooding would involve completely lining the river channel Recognition of this expense led to the project's vision being revised for the fourth time with a less ambitious scope to help reduce costs The revised scope aimed to provide an enhanced (as opposed to restored) riverside environment which would encourage enjoyment and use of the park without increased flood risk During this period of investigation, the NRA were forced to withdraw their project from its Millennium bid (October 1997) as the Millennium Marque did not want to see the project's scope and design changed Following this withdrawal, the NRA could not afford to line the river, thus a decision was made to investigate a yet more financially modest scheme with further reduction of the project's scope Prior to doing this, the project was entered by the NRA into an evaluation matrix to help decide whether or not to continue with it In this matrix QMRG scored 24 points making it a high priority scheme Following this appraisal, a further scaled-down design for the site was formalised, with a new cost estimate of £152,086 thus enabling the project to be proceeded with once money became available Since this period the project has stalled again in 1998 due to financial constraints Should the project go ahead in the future Halcrow's designs will be yet again revised to encompass both cheaper and softer alternatives (Christine Cranfield, Interview, 18/06/2001) The scaled down *final vision* will be mainly an aesthetic improvement The project will no longer be a 'restoration' but an 'enhancement', with reduced levels of excavation than previously proposed in order to avoid flood risk and to reduce costs This project will remain on hold until adequate funds are matched by London Borough of Bromley

6.2.2 Cole River Restoration Project: appraisal structure

In contrast to the QMRG, the CRRP's appraisal was clearly structured from the outset (see Table 39), and was undertaken over five years (1994-1999) The CRRP commenced with a phase of pre-project appraisal (1994-1995) which involved site selection and baseline data collection Over the next year a phase of design, 'visioning' and tendering was embarked upon, followed by a construction period of 4-5 months (summer 1995) which was suspended over the winter of 1995 and completed in the summer of 1996 The final phase of the project (1996-2001) involved two stages of post-project appraisal, the first broad and the second specific

Table 39. A timeline of the CRRP appraisal process

1990	River Conservation Conference (York) - Concept of RRP created
1991	RRP formed
1992	RRP applied for EU Life money to undertake two demonstration projects
1993	EU Life application successful
	Site Appraisal and Selection (17 potential sites delineated)
1994	**Pre-project appraisal (design phase):**
	Monitoring Programme Year 1- baseline date collected throughout whole year
May	Project co-ordinator employed
Autumn	Project Manager circulated sketch options- members askedto draw ideas on site maps
September	Project boards commenced design process
December	Meeting to discuss channel position, gradient, planform, location of reedbeds
	Working Group Meetings commenced
	Surveys Existing studies/data, fisheries, general constraints, invertebrate studies, land/river uses, landscape, public perception, recreation, amenity, hydraulics, morphology, site histories, soils, topographic surveys, water quantity and quality, and wildlife studies
1995	**Construction phase:**
Spring	Monitoring Programme Year 2- more baseline data collected
June	Separate project boards met to finalise designs
	Physical channel works began
July	Construction work started upstream
September	Meanders cut in downstream reach
November	New channel to original river
	Physical channel works completed
December	Flood- construction sediments washed away
1996-1997	**Project completion- fine-tuning:**
	Monitoring Programme· Year 3
	1996+ Post-project monitoring (macroinvertebrates Jun-Nov, wetland macrophytes Sep) Contingency budget spent on refining channel form and a backwater meander
1998-2001	**Post-project appraisal phase (NERC):**
1998-2001	NERC connect B project
1999	Final monitoring report on the effects of river restoration on the demonstration sites
2001 (July)	Workshop on NERC connect B project

This appraisal structure is now examined to ascertain what was appraised and how this appraisal was undertaken On the CRRP, project appraisal was referred as 'monitoring', however as was seen in Chapter 2 the researcher sees monitoring as a component of appraisal and thus the term was substituted with 'appraisal ' Prior to the Cole site being selected for restoration, aims and objectives were drawn up for a rural restoration site (see Table 40a), and these were kept sufficiently broad so as to be flexible and adaptable to achieve site-specific goals (Richard

Vıvash, Interview, 13/03/2001) However, once the site was selected, appropriate site-specific objectives were created (see Table 40b) to fit in with the EU Life fund's overarching aims (see Table 40c)

Table 40. Aims and objectives of the CRRP

a) Demonstration projects aimed to:
- Restoring 2 5 Km of river channel from straightened, deepened profile into a meandering, shallow profile Improving biodiversity, re-establishing flood regime, integrating the river into floodplain
- Working with others in selecting suitable sites and develop partnerships with organisations with professional expertise, enabling change through their legal powers and responsibilities
- Investigating opportunities and constraints at suitable restoration sites, the professional design of the programme of proposed works, and the execution and demonstration on site of these changes
- Monitoring of the effects of the changes on a whole range of aspects from invertebrates of the river and floodplain to the public's perception and economic consequences of the changes

b) CRRP objectives were to:
- Restore the river and floodplain's physical features, flood storage, habitat diversity and appearance
- Apply innovative restoration techniques and best management practice a sustainable rural system
- Further knowledge and understanding of river restoration by a very high degree of monitoring, and by practical demonstration of the results

c) EU Life aims:
- Establish three European demonstration and apply new and state-of-the-art techniques to the restoration of natural habitat in damaged rivers and their floodplains
- Demonstrate benefits of river restoration for Integrated Catchment Management
- Involve, motivate and train those who influence/undertake river management work
- Widely disseminate information about river restoration using pan-European networks

Sources Driver, 1997 371-372, EA, 1998a 114, Holmes, 1998a 341-343, Holmes 1998b 142-144, and RRP, 1997 1

(i) Pre-project appraisal (autumn 1994 to spring 1995)

Site appraisal and identification Prior to the Cole being selected for restoration, previous surveys had already identified a need for its enhancement due to reduced physical habitat (caused by impoundments), the existence of low flows and the past effects of pollution incidents (Sear and White, 1994 4) This preliminary (informal) appraisal was followed by a formal phase of site appraisal, culminating in the identification of the two EU Life demonstration sites To facilitate site selection, Vivash and Biggs (1994 8) developed a three-staged subjective scoring system which involved 1 observing and recording site-specific information, 2 numerically scoring each site against predetermined criteria, and 3 comparing scores for each site on a like-for-like basis Using six parameters (see Table 41) scores for each project were summed (to a maximum score of 100), and the highest scoring sites were selected

The RRP had to demonstrate through use of 'state-of-the-art' techniques how to successfully restore a river, thus 'multiple-degradation' was an important site selection parameter as it enabled a wide range of techniques to be demonstrated A compliant and responsible landowner was also a key selection criteria, because RRP had to be able to start the project quickly (Jeremy Biggs, Interview, 20/03/2001) These landowner requirements restricted the number of possible sites to select from Site selection was also further circumscribed to the

Thames region, because the RRP, the project board and working group members (from the NRA) wanted to work on a project close to home (Alastair Driver, Interview, 21/02/01) Using this matrix, the River Cole was found to score continually high, and it was unanimously agreed by those involved in this appraisal (RRP and NRA) that the Cole be carried forward as the preferred rural demonstration site The Cole was also favoured because it was owned by the National Trust (hence the site's future protection was secured) It was also easily accessible and was degraded, offering 'a greater range of reversible degradations than other candidate sites' (Holmes and Nielsen, 1998 190)

Table 41. Six site-selection parameters for the CRRP

1	**Aims.** Offer potential to achieve broad aims of river restoration, involve river and floodplain, benefit wildlife, landscape, recreation, amenity, and local heritage features
2	**Technical.** Site-specific project must illustrate a wide range of degradations that can be reversed, measured, and developed with confidence Reversibility must be technically feasible
3	**Funding.** Must be capable of being funded on adequate and secure basis ensuring short and long-term economic viability through funding partnerships
4	**Ownership.** Owners must be committed to aims of restoration and must be willing to take part
5	**Promotional.** Must support RRP's wider aims of influencing, through demonstration, the rate and extent of achievement elsewhere, advance knowledge and understanding of restoration techniques
6	**Risks.** Risk of failure should be small and should be controllable by RRP or funding partners

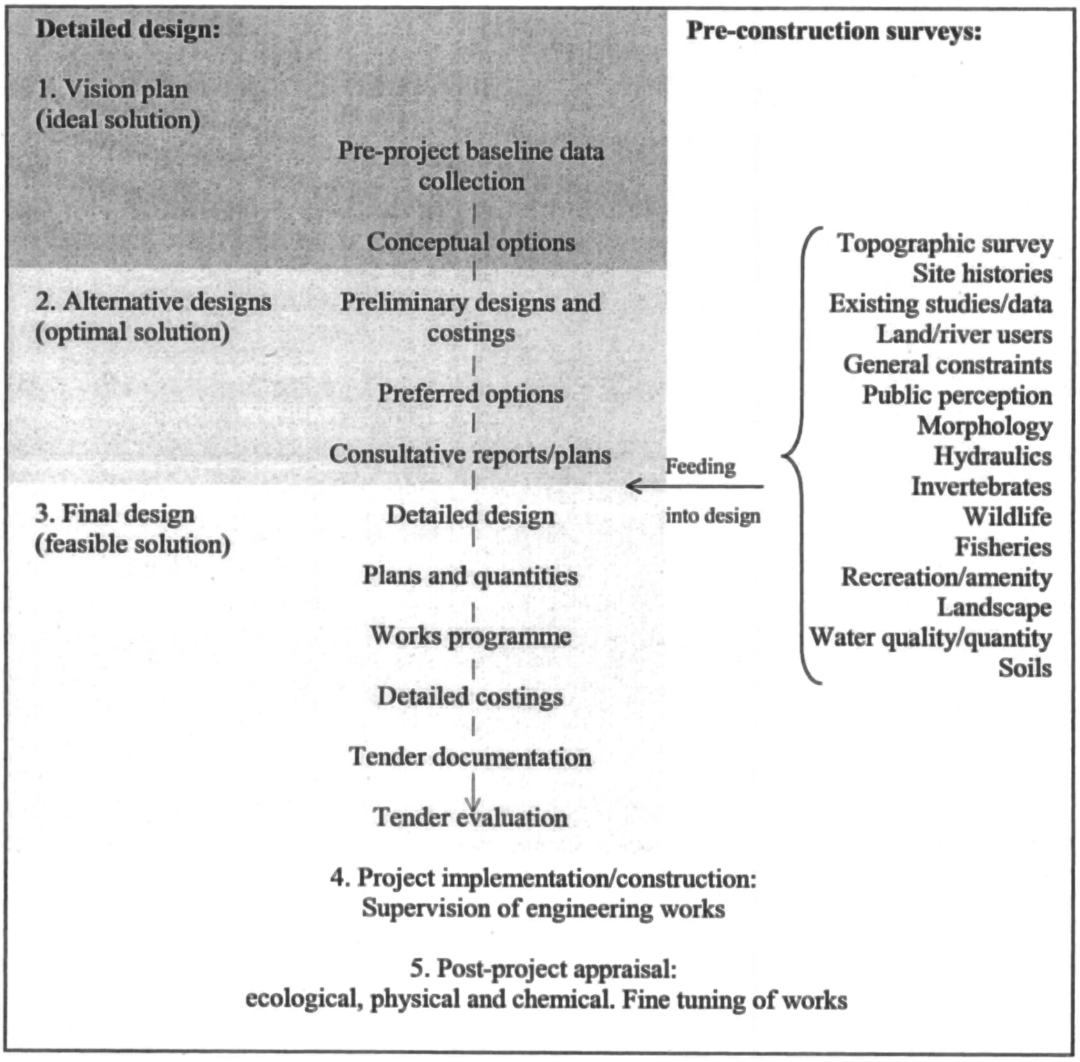
Source Vivash and Biggs, 1994 4

Baseline data collection Following site selection, the Cole underwent a phase of pre-project appraisal This comprised a full background study of the site to ensure that 'the river and the surrounding area was thoroughly understood before any plans were drawn' (RRP, 1997 1), and would also enable pre- and post-project comparisons of the site A broad range of baseline data were collected during this appraisal, on ecology, hydrology, geomorphology and water quality The purpose of this wide scope was to enable any components to be revisited during post-project appraisal and future research programmes as EU Life had specified that one third of their funding be set aside for monitoring, the aim being to demonstrate project success During this phase of appraisal a control reach was delineated two kilometres upstream of the restoration reach, and an 'impact reach' downstream of the restored reach, to enable the effects of the restoration to be appraised

(ii) Creation of a vision plan

The CRRP's design commenced with a visioning phase, into which were fed relevant pre-project baseline data Holmes and Nielsen (1998 193) subdivided this phase into three stages 1 vision plan is developed for the site providing the 'ideal' solution, 2 vision is then followed by alternative designs referred to as 'optimal' solutions, and 3 final vision is derived from development of most 'feasible' solution (see Figure 24) Both the project board and working group were involved in this stage of appraisal Working group members drew onto site maps their design requirements and the elements they wanted to see included in the project irrespective of cost (Cole Working Group meeting, 08/02/1995; and Richard Vivash, Interview, 13/03/2001). These sketches were collated, and the cost of undertaking all requested elements was estimated at £330k. This costing far exceeded the project's budget (£298k), and as a result design components were ranked in order of priority, with components necessary for project success implemented as a priority. During this initial visioning phase the members of both management groups fed in their individual expertise within specific fields. Also at this stage design constraints such as the requirement to maintain the mill leat and Coleshill FC's football ground were considered.

Figure 24. Stages of project design on the CRRP



Source: adapted from Holmes and Nielsen, 1998: 193; and RRP, 1993: 80

Geomorphological input into the project's vision was also undertaken at this stage. An examination of historical baseline data and analogue reaches (selected to represent semi-natural/recovery reaches) helped ascertain how the river looked prior to disturbance. This informed the design of the 'vision', enabling the derivation of width-depth ratios and the scale and presence of specific physical features Natural channel dimensions were then used to design 35% of the restored course, with the remaining 65% requiring larger dimensions to facilitate flood conveyance (RRP, 1999 9) Natural cross-sections were found to be smaller prior to channelisation $10m^2$ as opposed to $50m^2$ Natural depths were also much smaller, and 1 5m below ground as opposed to 2 5-3 5m (RRP, 1999 9)

Appraisal of vision plans Once the components of the vision had been decided upon by both management groups, the working group then provided the contractors with plans which were formed from survey information This enabled basic lines and shapes to be put on paper (Richard Vivash, Interview, 13/03/2001) The consultants (Halcrow and Hydraulics Research Wallingford) then developed the 'vision' into contract drawings and through unsteady-state modelling were able to derive actual channel sizes and dimensions These dimensions were then re-appraised against the vision to ensure congruity with the initial designs Through this visioning phase, the management groups gave contractors 'a first assessment of the creature they wanted to create' (Richard Vivash, Interview, 13/03/2001), with designs being kept broad so as not to restrict what was planned later if more money became available such as through tax rebates (Martin Janes, Interview, 08/05/2001) Tenant farmers were also consulted at this stage by Richard Vivash (RRP), and the National Trust representatives, enabling them to become actively involved in the appraisal throughout, and incorporating their requirements into the design process

Appraisal of final design options Four design options arose from this 'visioning' phase (options 1 and 2 for the upstream reach, options 3 and 4 for the downstream reach) In the upstream reach, option 1 aimed to retain the old channel as a series of linear ponds, raise ground and bed levels, build a reedbed area and restore the channel near the mill leat Option 2 aimed to build an anastomosing channel furthest upstream, construct a reedbed and restore the old channel close to the mill For the downstream vision, option 3 aimed to retain the old channel as a series of linear ponds and build a reedbed area Option 4 aimed to raise the channel by 1m and create berms around the banks These options were then appraised by the working group and the anastomosing channel was rejected because it was not a 'natural' geomorphological feature on the River Cole (Cole Working Group meeting, 24/10/1994) This phase of appraisal culminated in the creation of a final vision which broadly aimed to re-meander the river along its old course upstream and re-introduce a meander downstream (see Table 42)

Hydrological appraisal of final design options Hydraulics Research Wallingford were commissioned by RRP in 1994 to determine the hydraulic impacts of 1 in 2, 10, 50 and 100-year flood events for the project's final vision and tender plans This appraisal was undertaken in order to prove that flood risk would not be augmented and was a necessary requirement for the project to obtain land drainage consent (Karen Fisher, Interview, 02/05/2001) SALMON-F and RIBAMAN hydrological models were used to predict increases in flood frequency, using cross-sections (trapezoidal on straight reaches and triangular on bends) delineated in the tender plans to simulate flood events for the restoration options It was found that all of the restoration options would increase water levels, with the river coming out of bank 17 days a year (5% of year) compared to pre-restoration rates of 4 hours per year (0 05% of year) These results influenced the project's appraisal, enabling the channel to be redesigned to simultaneously allow water onto the floodplain without increasing flood risk, as stipulated in EU Life's aims This was achieved by retrofitting the channel's new dimensions to suit the catchment's existing hydrological regime

Table 42. Restoration measures included in the CRRP

Restoration included
- Restoration of a new channel in the historic course occupied before diversion for milling
- Creation of meanders in straightened reach raising bed, channel narrowing and backwater creation
- Reprofiling the historic old channel that had been restored to take extra flow
- Increasing flooding and floodplain storage
- Reintroduction of historical landscape elements
- Improvement of hydrological connectivity of river and fritillary meadow to aid recovery of meadow
- Creation of floodplain meadowland through conversion from arable cultivation
- Raising of water tables to increase winter flooding of existing grasslands
- Continuation of sustainable farming
- Recreation of sustainable natural processes self-sustaining channel sizes and floodplain flooding
- Creation of a reedbed habitat feature with a water treatment function at the outflow of the ditch

Restoration in upstream section
- Reinstatement of original course above the mill at Coleshill (including an infilled meander loop)
- Construction of sweetening flow in the mill bifurcation structure to split the flow
- Increasing channel slope creating self-sustaining regime, increasing flood storage on the floodplain

Restoration in downstream section.
- Restoring old bed levels, water levels and flood regime
- Cutting of a 700m re-meandered course across old channel, raising bed levels by infilling 1 2m
- Increasing habitat diversity

Source EA, 1998a 114

Project construction and completion (1995-1996) Throughout the project design stage the initial contract value (£80k) was supplemented as RRP fundraised an additional £40k, which enabled more work to be undertaken than originally planned (Richard Vivash, Interview, 13/03/2001) A contingency fund was also set aside to act as a buffer against the unexpected (Vivash *et al*, 1998. 205) and, following construction, this contingency was spent on design components which had not been undertaken but were next in rank. This enabled an additional meander to be built onto the original design, rejoining an old line of willows to the river For Keith Blaxhall (Interview, 15/05/2001) of the National Trust, this additional meander was the most successful component of the entire restoration project

(iii) Post-project appraisal (1996-2001)

As a showcase example of how river restoration should be undertaken, one of the most important components of the CRRP was its monitoring programme This was necessary to demonstrate to the EU and the public the benefits of restoration Thus, following construction, two phases of post-project appraisal were undertaken The first phase (1996-1998), undertaken by the RRC, was very broad-based The second phase (1998-2001), a NERC Connect B project (see Biggs and Sear, 1998), was a more focused eco-geomorphological appraisal The first phase of project appraisal analysed data collected during a basic monitoring documenting the environmental benefits of restoration (Kronvang *et al*, 1998· 211) Results from this post-project appraisal (see Table 43) showed general improvements to geomorphology, plant, invertebrate and fish assemblages, all of which either reached or exceeded pre-restoration conditions (RRP, 1999 39) During the post-project appraisal, public perception (Sue Tapsell and Sylvia Tunstall, FHRC), ecology (Jeremy Biggs, Oxford Brookes University, see Biggs *et al*, 1998b) and geomorphology (Alison Briggs and David Sear, Southampton University, see Briggs, 1999) were focused on in greater depth These detailed post-project appraisals were undertaken in this way for the following three specific reasons Firstly, the public perception work was undertaken to enable cross-comparison with perception work undertaken by FHRC on the urban river Skerne Secondly, the nature of the ecological post-project appraisal undertaken was largely influenced by Jeremy Biggs' affiliation to the Pond Conservation Trust and his background as a Freshwater Biologist Thirdly, the geomorphological appraisal formed part of a Doctoral Research Studentship into 'The geomorphological performance of restored and rehabilitated rivers' (undertaken by Alison Briggs from 1995 to 1999 at Southampton University)

Results from the post-project appraisal (1997) showed that the general public at Coleshill did not view the scheme in an entirely favourable light, partly because the newly created banks looked 'raw' (Sylvia Tunstall, Interview, 27/11/2000), but also because respondents were aggrieved that they had not been consulted at an earlier stage During the ecological appraisal Biggs *et al* (1998b) compared macroinvertebrate and macrophyte assemblages before and after restoration, finding that restoration had not had a negative effect on the Cole's ecology The geomorphological post-project appraisal showed that, following restoration, sediment storage features dominated, whereas prior to restoration the Cole had been characterised by impoverished morphology and fine sediment benches which provided little connectivity between the river and its floodplain (Briggs, 1999 153) This appraisal specifically demonstrated the Cole's geomorphologic response to restoration, and the geomorphic adjustments which followed restoration, highlighting restoration's success as a tool for re-establishing natural geomorphological processes in rivers

Table 43. Results of the CRRP post-project appraisal

- **Geomorphology.** Numbers of natural in-channel features increased after restoration Erosion and deposition-generated features increased in number Evidence of extensive sedimentation downstream of the restoration led to localised raising of bed levels and a small increase in numbers of berms
- **Hydrology** The river upstream of Coleshill bridge is predicted to be out of bank 17 days a year (5% of the year) compared to previous 4 hours per year prior to restoration (0 05% of the year)
- **Vegetation.** Plant species richness increased immediately after restoration as bare ground was colonised by wetland annuals On the new channel downstream of Coleshill bridge, marginal-emergent plant species richness increased significantly from 27 to 38 species per 500m length, with four times as many wetland species per $2m^2$ quadrat after restoration Plant SRI values on the Cole recovered rapidly to pre-restoration levels
- **Aquatic invertebrates.** Detailed assessments of changes in invertebrate assemblage conservation value were made Prior to restoration the aquatic invertebrate fauna of the Cole was of moderate-high conservation value 1-2 months after restoration upstream restoration reach and downstream impact reach showed evidence of moderate decline, nine months later there was little evidence of impact or change in species rarity One year after restoration invertebrate species richness reached 50% of pre-restoration value
- **Birds.** One year after restoration no change in number of wetland species, increase in Yellow wagtails
- **Fish.** After restoration, biomass and density quickly returned to pre-restoration levels Highest biomasses and densities were found in restored sections in areas of gravely eroded substrate Highest biomasses and densities were recorded in the downstream impact reach, the upstream control reach showed a slight decline Fish species richness generally remained unchanged both in the restoration, control and impact reaches
- **Economic.** Overall annual economic benefits of the CCRP covered a range from £38,000-£347,000

Source adapted from RRP, 1999 8-55

The second phase of post-project appraisal aimed to assess the project's success in improving biodiversity at the catchment level, and a NERC Connect B grant (funded 50 50 by NERC and the EA) was gained by David Sear (Geomorphologist, Southampton University) and Jeremy Biggs (Freshwater Biologist, Oxford Brookes University) to undertake three additional years of post-project appraisal (1998-2001) The ensuing research project was entitled 'Processes controlling the effectiveness of river restoration as a means of enhancing lotic biodiversity' and its design reflected Biggs' and Sear's individual research agendas as this work was no longer beholden to EU Life or RRC's requirements This resulted in an appraisal which was more specific than the previous post-project appraisals, focusing on the Cole's geomorphology and ecology (David Sear, Interview, 15/03/2001) The researchers undertook surveys to characterise the physical habitat of restored and control reaches, macrophyte and macroinvertebrate communities in restored and control reaches, and to investigate local propagule sources (see Table 43 and 44) Results from this post-project appraisal showed that restoration had not improved biodiversity at the catchment scale and had made only a limited contribution to the regional species pool (98% of taxa was already present within 5km of the site, Sear *et al*, 2001 3) However, at the reach scale biodiversity had been improved, with the same sorts of organisms distributing themselves slightly differently due to the changes in physical habitat, but with no new species colonising these new niches (David Sear, Interview, 15/03/2001) This highlighted the importance of restoration taking a catchment as opposed to a channel focus Although the RRC's appraisal of this project is now complete, the Cole is still subject to a range of post-project monitoring activities undertaken by researchers, students and by the EA

Table 44. Details of surveys undertaken during river River Cole NERC project

Survey of channel mesohabitats
• Stratified hierarchical sampling strategy (using a $2m^2$ quadrat, thrown randomly in both lateral and longitudinal directions) to assess spatial heterogeneity at three scales 1 Restored length, 2 Major geomorphological units (e g meander), and 3 Mesoscale geomorphological variation (channel base and edge variation) The differences across these three scales compared to the control section A geomorphological survey mapped restored and control channels, locating and defining structural mesohabitats In each sampling unit biotic and physical variables measured during two seasons
• Biotic variables macroinvertebrate species present and species abundance, macrophyte species present, and percentage cover of each species and vegetation height
• Physical variables location, elevation, geomophological unit, aspect, water depth, current velocity, shear stress, bank slope and height, shade, substrate particle size distribution, detritus organic matter, and water chemistry taken at control reach and between the restoration and impact reach
Catchment scale changes in biodiversity
• Estimate nearest sources of colonising species through catchment over $10km^2$ in two seasons
• Macroinvertebrates surveyed (2 stratified random samples) to estimate colonising pool 30-50 3 minute hand net samples in Cole, tributaries, other waterbodies and on the wetland

Source Biggs and Sear, 1998 1-7

6.2.3 Upper Kennet River Restoration Project: appraisal structure

The UKRP was conceived in 1999 and was to be executed in three clearly structured phases of appraisal by 2004 (see Table 45) From the start the overall aim of the UKRP was to

> 'Design, implement and monitor, rehabilitation measures along 10km of the Upper River Kennet to achieve a range of environmental enhancements and be a catalyst to encourage further restoration work in the future' (TW, 2001 1)

This would be achieved through the following objectives

- Redress through rehabilitation some of the degradation caused by past management techniques which had degraded chalk stream characteristics (Crafer, 2000 75) to benefit
  - Habitat (protection of BAP species and SSSI),
  - Amenity (Upper Kennet valued for fly fishing and also as a community asset),
- Use cost-effective techniques to achieve flow velocities to sustain *Ranunculus* spp , a key species on the Upper Kennet (Mike Crafer, Interview, 18/07/2001),
- Monitor and trial innovative techniques, and
- Disseminate project results

Table 45. A Timeline of the UKRP appraisal process

1979	Abstraction from the Kennet began	
	Anglers first noticed a reduction in *Ranunculus* spp. And brown trout	
1988-1993	Public perception study undertaken by Flood Hazard Research Centre (FHRC)	
1993	Public meeting the Upper Kennet - First Action plan launched	
1994	Upper Kennet public perception study report (produced by FHRC	
	Catchment Landscape Assessment (produced by Landscape Associates)	
1996	Public enquiry	
	PHABSIM: Habitat Mapping (Department of Geography, Worcester)	
1997	Catchment Management Plan	
1998	Environment secretary set minimum flow in Kennet at 90 $Ml.d^{-1}$	
Upper Kennet Rehabilitation Project Conceived		
1999	**Phase 1**	**Monitoring**
October	Demonstration project near Mildenhall	
December	Phase 2 options report - 13 sites prioritised for rehabilitation	
	Detailed Catchment Baseline Survey (Geodata Institute)	
2000	**Phase 2**	
January	4 sites selected for rehabilitation	
April	Phase 2 feasibility study. Fluvial Audit (Geodata Institute)	
Summer	*Ranunculus* spp. planting trial at Raggs' Hatches completed	
Autumn	Floods cause delays	
	Completion of Harbrook project	
	Monitoring of Phase 2	
2001	**Phase 3**	
January	Phase 3 options report - Two further sites are still available for rehabilitation	
February	Outbreak of Foot and Mouth causes delays	
	Completion of Hopper's Lane project	
2002	Projects running over due to delays	
	Monitoring of Phase 3	
2003	Post-project monitoring	
2004	End of monitoring (no more budget)	↓

These aims and objectives were executed in three phases. Phase 1, the demonstration project, was successfully completed in 1999 prior to the selection of rehabilitation sites for the remaining three phases. However, the original time plan for the project had to be altered when severe flooding in autumn 2000 delayed the commencement of three projects in Phase 2 (White Bridge, Harbrook, and Howe Mill). This delay was further exacerbated by the outbreak of foot and mouth in February 2001 (Yvette De Garis, Interview, 18/07/2001). However, these three projects were later completed in autumn 2001. These delays had an influence on the project's appraisal, causing the post-project appraisal to be shortened for Phase 2 and 3 projects. Despite these delays, the early completion of Phase 1 ensured that three years of monitoring could be undertaken for the demonstration site. This section traces these three phases, looking in detail at the structure of the appraisal and the techniques employed.

(i) Phase 1: Demonstration project (October 1999)

The Phase 1 demonstration project was established on a 340m reach near Mildenhall which was over-wide, shallow and of slack velocity (due to dredging). This phase was very opportunistic and took place prior to steering group selection of rehabilitation sites for Phases 2-3, with project partners developing Phase 1 as a tool to gain landowner support for the other two phases. According to Kevin Patrick (Interview, 24/04/2001), it was important to get something done in the first year 'to announce our arrival and get some experiments going', providing output up-front. This was achieved by demonstrating, through use of a range of techniques, what the project as a whole was trying to achieve (Nigel Holmes, Interview, 24/04/2001). The aim of the demonstration project was to improve habitat for *Ranunculus* spp., for fish and invertebrates. This was achieved by channel narrowing and habitat reconstruction, whilst also trialling and monitoring innovative bioengineering techniques which included:

- Creation of an in-channel linear ledge forming a reed/sedge swamp;
- Creation of *Ranunculus* spp. snow shoes (using hazel frames) to encourage colonisation;
- Planting hazel faggots and chestnut stakes to narrow channel, encouraging sedge growth;
- Construction of a sedge bed using planted material and natural recolonisation;
- Construction of silt groynes to encourage sedge fringe extension; and
- Construction of narrow and wide reed swamps behind hazel faggot revetments.

Phase 1 also acted as a precursor to the pre-project appraisal, during which sites were selected for Phases 2 and 3.

(ii) Pre-project appraisal

Once the demonstration project was completed, and landowner support gained, a phase of pre-project appraisal was embarked upon as the basis for the development of a detailed project plan and programme (Patrick, 2000: 7). At the pre-project stage, Kevin Patrick and Nigel Holmes walked the length of the 10km reach and got to know the river by talking to landowners and river-keepers. According to Nigel Holmes this period of negotiation and site visiting played an important part in the pre-project appraisal. It helped to ascertain the degree of degradation, opportunities for rehabilitation and the views of the landowners. This phase also enabled him to 'see the river over the seasons and its changes in terms of character' (Nigel Holmes, Interview, 24/04/2001). Through this reconnaissance visit the condition of the reach was appraised, and professional judgement combined with stakeholder knowledge was used by the project manager and director to classify the river into three types of reach: 1. good sections of classic chalk stream habitat (fast flow, good gravel bottoms, and thriving *Ranunculus* spp. beds) suitable for floodplain restoration; 2. either widened or deepened, leading to flow sensitivity; and 3. very deep, sluggish and silted, badly damaged over time.

Once the three broad river types were identified, further surveys enabled the appraisal of the flow-sensitive and deeper sections, with Nigel Holmes delivering a view on which sections would bring the best results in terms of investment (Mike Crafer, Interview, 18/07/2001). Following this appraisal a series of options were produced in a report which described 13 sub-reaches and their rehabilitation potential since the wholesale enhancement of all 10kms was not an option due to monetary and practical constraints (Mike Crafer, Interview, 18/07/2001). These 13 sub-reaches were selected using six criteria which all had to be met (see Table 46a). The next stage of the appraisal process involved the steering group selecting four projects (out of the 13 identified) for Phase 2 of the rehabilitation works. Phase 2 projects initially comprised of in-river and floodplain projects (Appendix K). However, some landowners were not willing for the floodplain projects to go ahead, preventing all such projects since it was not possible to flood some people's land and not others (Kevin Patrick, Interview, 24/04/2001). To facilitate this selection process a project selection matrix was developed by the partners, with the delineation of eight scoring attributes (see Table 46b). During this appraisal, steering group members had to ensure that they did not select all projects with the same landowners, in the same geographical area, or covering the same type of problem (Nigel Holmes, Interview, 24/04/2001). It was also necessary to take into account whether landowners were going to be a help or a hindrance to the project, and whether consent requirements would make project implementation too difficult. This scoring process took place in two stages: 1. using quasi-scientific criteria to objectively prioritise projects; and 2. considering additional subjective or contextual criteria (TW, 1999: 2).

Table 46. Site selection criteria and matrix for the UKRP

a) Six criteria used to select the 13 sites:
1. Owner support (essential)
2. Either: 'serious' degradation that can be reversed; or 'reasonable quality' that can be enhanced
3. Minimum size (works must make a significant difference, >50m cut-off)
4. Value for money (should make a difference without exorbitant costs)
5. Practicality (access and other implementation issues must be resolvable)
6. Consents (a fair chance that all necessary permissions could be obtained)

b) Site selection matrix based on eight scoring attributes:
1. Contribution to the improvement of characteristic ecology
2. Degree/extent of the works
3. Visually restored chalk stream character
4. Visibility and access
5. Contribute to self-sustaining fishery
6. Meet implementation and consenting requirements
7. Need for flood risk assessment
8. Cost per unit area

Source: De Garis *et al.*, 2001: 6; and TW, 1999: 1 and Appendix C1

Stage one enabled the projects to be ranked in order of preference, and stage two enabled projects to be investigated in light of additional information. The selection matrix enabled schemes to be identified which would be the best for wildlife, landscape and people; would not cause flood risk; would be cost effective; and, most importantly, would be acceptable to landowners (Mike Crafer, Interview, 18/07/2001). At a steering group meeting (January 2000), the scores of all the members were aggregated and an average calculated for each project, enabling projects to be prioritised in rank order. Thus site selection was undertaken democratically, with the project director and manager unable to vote or influence this process. At this stage of project appraisal and selection the landowners, as the principal stakeholders, were heavily involved, as their input was essential for gaining permission to use their section of the river (Mike Crafer, Interview, 18/07/2001) Following this selection meeting the project partners came away with a 'clear sense of a pecking order, a prioritisation of all the different projects right down the scale' (Kevin Patrick, Interview, 24/04/2001) This pecking order culminated in the selection of four sites Raggs Hatches, White Bridge, Harbrook and Howe Mill (see Table 47) This prioritised list was not only important for selecting sites at the preliminary stages but was also returned to during site selection in Phase 3

Table 47. Description of UKRP Phases 1-3 projects (cost estimates at time of writing (2003) not necessarily actual costs))

Site name	Length of reach	Cost estimate	Nature of rehabilitation
Mildenhall (Phase 1)	340m	No data	Channel narrowing and habitat reconstruction
Raggs Hatches (Phase 2)		No data	*Ranunculus* spp Trial
White Bridge (Phase 2)	60m	£13,000	Reed/sedge island in over-wide reach
Harbrook (Phase 2)	180-200m	£14,000	Habitat reconstruction • Narrowing and shallowing the river Point bar creation • Pond creation • 30m of deflectors to encourage faster flow
Howe Mill (Phase 2)	580m	Landowner funded	Habitat reconstruction • Narrowing using open (post and wire) deflectors • Coir rolls to stabilise and hold gravel • Shallowing using material from adjacent fields • Ponds creation • Vegetated ledges along garden side of mill
Durnsford Mill (Phase 3)	320m	£76,189 (£238 per m)	Habitat reconstruction • Shallow channel over c75% of river length using gravels from adjacent floodplain • Floodplain pond creation • Bed raised over c300m • Straw bales used as ballast to replace gravel
Hoppers Lane (Phase 3)	120m	£51,944 (£433 per m)	Habitat reconstruction • Narrowing and shallowing • Pond creation

Source adapted from TW, 2001 4

Prior to implementation the selected projects underwent a *pre-works assessment* This was essential for supporting a land drainage application, gaining SSSI consent, ensuring sufficient protection was given to the habitats of protected species and also ensuring flood risk was not increased (De Garis *et al*, 2001 6) Baseline surveys (Macrophytes, fish, invertebrates, water level, velocity data, and fixed-point photography (see Appendix K)) were also being simultaneously undertaken to enable the future monitoring of a range of biotic and abiotic factors, which would be used to illustrate changes from the pre-project benchmark Baseline data were collected in the most depth for Phase 1 since delays to the other phases meant that the longest data record would be collectable for this phase

(iii) Phase 2: Construction of three projects near Axford and Ramsbury (2000-2001)

The Phase 2 sites represented the three highest priority projects – White Bridge, Harbrook and Howe Mill – which had been 'cherry picked' (Kevin Patrick, Interview, 24/04/2001) by the steering group The aims of these Phase 2 projects were to encourage the spread of marginal reeds and sedges to the narrow channel, to construct an island within the channel to energise flow, to manipulate the channel to create self-sustaining pools, and to infill channels to raise beds

The White Bridge project aimed to accelerate flow in an over-wide reach by creation of an island and bed raising (see TW, 2000a, TW, 2000b and TW, 2000c) The Harbrook project aimed to improve habitat potential by narrowing and shallowing through creation of a point bar and a pond on the right bank The purpose of the Howe Mill site was to restore silted, sluggish conditions by narrowing the channel through use of deflectors Prior to implementation each project was appraised through an outline design summary, a feasibility study (undertaken by Richard Vivash) and an assessment of flood risk (see TW, 2000b) Also, pre-works surveys were undertaken for Desmoulin's whorl snails and water voles (protected BAP species) in order to ascertain their location and to thereby develop measures to protect them during construction Flooding in autumn 2000 meant that these three schemes became delayed until the following autumn although work on Howe Mill had already commenced

(iv) Phase 3: Selection of Durnsford Mill and Hoppers Lane sites (2001+)

Projects for Phase 3 were selected by the project manager and director, based on which projects were outstanding from the list, what they wanted to see done, and how much budget remained (Nigel Holmes, Interview, 24/04/2001) An options report aided this second phase of site selection, delineating Durnsford Mill and Hoppers Lane as potential sites The Durnsford Mill project broadly aimed to rehabilitate an over-deep and sluggish reach, and to improve habitat quality through channel shallowing, creation of a floodplain pond and bed raising For Hoppers Lane the creation of good *Ranunculus* spp habitat was planned, including a riffle/run sequence and a linear pond Limited funds and the logistics of delivering two large projects during one autumn meant that money was only available for one project, thus the two projects were subject to comparison (see Appendix P) A *risk register* was produced to ascertain which one was the least 'risky' on a scale of 1-5 (high-low) based on the likelihood of an event occurring and the severity of its consequences (TW, 2001 14) Despite Hoppers Lane being identified as the most advantageous and the least risky, the project director and manager were keen to implement both projects pending confirmation of contributory funding from project partners (TW, 2001 18)

However, the project partners finally selected Durnsford Mill as it would provide better value for money per linear metre

(v) Post-project appraisal: 2000-2004

For the post-project appraisal, it was decided to focus mainly upon specific change-indicators (e g Desmoulin's whorl snails, fish, fixed-point photography, invertebrates, macrophytes, plant growth, velocity data, water levels and water voles, see TW, 1999) which were likely to tell in the short term how well the projects were performing with respect to the pre-project baseline data (Mike Crafer, Interview, 18/07/2001) The programme of post-project appraisal also had to be cost-effective because it is not common practice for TW to undertake long-term environmental monitoring projects as they operate over five-year planning cycles (Yvette De Garis, Interview, 18/07/2001) The delays imposed by flooding and foot and mouth meant that it was decided to concentrate the post-project appraisal on the Phase 1 scheme because it had the longest data record, and would enable the appraisal of rehabilitation works and, in particular, the newly trialled techniques (Kevin Patrick, Interview, 24/04/2001) Phase 2 and 3 projects have been appraised, and the final year of the project (2003) was devoted solely to post-project monitoring, with some aspects of the monitoring programme being incorporated into the on-going survey programmes of the EA and English Nature

6.2.4 Summary

This section has traced the appraisal structures employed on three contrasting projects within the Thames region of the EA It has described the techniques used in specific components of appraisal, the timing of these appraisals and the constraints on each project's appraisal and development. As with the decision-making structures, the appraisal structures employed on these projects and the techniques selected differed significantly between sites (as will be seen in the following section), indicating that there is clearly no single way of undertaking appraisals Instead, the manner in which projects are undertaken is related to the financial and temporal constraints imposed upon them by funding bodies and the individuals undertaking the project

At Queen's Mead the manner in which the appraisal was structured was very much influenced by the timing of the public appraisal. Firstly, public approval for river restoration was derived through a study examining whether the local community would be in favour of a hypothetical river restoration project The acceptance by the public for this hypothetical project led to a decision by the NRA to undertake a river restoration project The public were not consulted on the project's design until it was almost ready to be implemented However, it was at this stage that the public indicated that the project could cause flooding At QMRG the timing of the phases of project appraisal led to the creation of an *ad hoc* appraisal structure which was punctuated by phases of inactivity whilst funding was bid for

The Cole project was unlike most other river restoration projects nationally and regionally as it possessed fewer financial constraints and because 'monitoring' was given pivotal importance in terms of funding allocations The appraisal framework utilised on the Cole was artificial in the sense that it was designed before the project was undertaken This led to the creation of a clearly structured appraisal framework This appraisal structure is unlike the other two case studies since their appraisal structures emerged alongside the projects as opposed to being designed in advance The Cole's project appraisal also had a highly scientific basis as the structure of the appraisal was designed to incorporate a range of disciplines However, despite this scientific background the site itself was selected using a highly subjective selection matrix

The Upper Kennet project differed from the previous two projects due to its highly politicised beginning, and the fact that it was undertaken on privately owned land The appraisal framework adopted here enabled different components of the overall project to be undertaken at different times. This appraisal structure, referred to here as a phased approach, was important given the physical scale of the project and the fact that land ownership was varied This project demonstrated the benefits of having a trusted figure such as Nigel Holmes involved in the project, who was useful in dissipating public concerns and discussing the projects in an informal manner with stakeholder groups

The different appraisal structures employed on these projects resulted from the fact that each project possessed very different backgrounds, both socially and physically Additionally, they were all undertaken at different times and the approaches taken were very much influenced by the political climate and the nature of river restoration practice at the particular time of the appraisal For example, concepts such as geomorphological and public appraisal were not so often included in the earliest river restoration projects in the UK as seen in Section 6 2 1

On all three projects factors such as the amount of and the timing of funding influenced both the extent of and the timing of these appraisals This was especially the case on the QMRG (Section 6 2 1) whereby certain components of a project had to be undertaken within specific time frames so that money was spent before the end of the financial year

The differences between the appraisal structures can also be seen to be related to the very different decision-making structures, which were discussed in the previous chapter. These decision-making structures and the individual decision makers included within these structures, influenced the effectiveness of these appraisals, the manner in which each project was implemented and the extent of the public involvement in these projects For example, on the UKRP (Section 6 2 3) the shape of the appraisal structure was very much influenced by the need to be seen to involve all stakeholders in the decision-making process However, the components of the project's appraisal which were undertaken were largely influenced by the key decision makers disciplinary backgrounds

6.3 Evaluation of the case studies appraisal structures

This section evaluates the appraisal structures employed on the three case studies (see Figure 25a-c) against the appraisal framework outlined in Chapter 2 The appraisal structures of each project are evaluated to see how clearly and logically they were executed; how far they embrace components of the structure depicted in Chapter 2, and the factors which constrained the deployment of a structured approach

As has been shown above, at QMRG, the appraisal was unstructured and *ad hoc* due to financial and design constraints which meant the project went through pulses of activity and inactivity (Section 6 2 1) The CRRP, in contrast, was extremely clearly and logically structured because the benefits of the project had to be demonstrated to its funders The UKRP on the other hand was undertaken in phases, reflecting the physical and temporal constraints produced by ephemeral chalk streams (Section 6 2 3)

Each case study undertook two stages of pre-project appraisal (numbered sequentially to indicate which phase of pre-project appraisal was undertaken first) with the first stage of pre-project appraisal (1) being followed by a second formal phase of pre-project appraisal (2) On the Cole this phase involved detailed collection of baseline data, at QMRG this phase was a feasibility study and on the UKRP rehabilitation sites were selected through a site selection matrix These structures are now evaluated in relation to the model set out in Chapter 2

6.3.1 Evaluation of the QMRG appraisal structure

At QMRG the two main issues which influenced the project's appraisal was the timing of the various stages of the appraisal, and the manner in which public appraisal was undertaken In Figure 25a it can be seen that the QMRG appraisal was structured such that the vision for the site was drawn up prior to public consultation This vision was then utilised in a feasibility study, and in a later hydrogeological appraisal the risk of basement flooding was identified, which meant that the project had to go through a subsequent phase of redesign Had the appraisal been more systematically structured from the start then the need for this phase of redesign may have been avoided, and money and time saved as the risk of basement flooding would have been identified earlier on and hence mitigated against in the design. The unsystematic manner in which this appraisal was undertaken thus led to both money and time being wasted

The appraisal framework depicted in Chapter 2 emphasises the importance of undertaking a desk study, identifying the problems which need restoring and then developing clearly defined aims and objectives to achieve the project's goals This is referred to as Phase 1 of project appraisal, and is the phase where pre-project baseline data is collected to assist the project's design and is also used in later post-project appraisal to assess whether the project's goals have been met

Figure 25. Appraisal structures employed on the three case studies

a) QMRG	Ad hoc appraisal	b) CRRP	Clearly structured appraisal	c) UKRP	Phased appraisal
Pre-project (1):	Ecological assessment Geomorphological assessment Public perception work	**Pre-project (1):**	Site selection via matrix	**Pre-project (1):**	Public perception work Public meeting Landscape assessment Public enquiry PHABSIM Catchment Management Plan
Pre-project (2):	Landscape assessment Feasibility study Hydraulic investigation	**Pre-project (2):**	1 year Baseline data collected (Monitoring Year 1)	**Pre-project (2):**	Rehabilitation sites selected via matrix Detailed Catchment Baseline Survey
Design:	Formal designs/vision	**Design:**	Options design sketch Long design process Surveys undertaken (Monitoring Year 2)	**Design and Construction:**	**Phase 1.** Demonstration site established **Phase 2.** 4 Sites selected Feasibility study Fluvial Audit **Phase 3.** Options report two more sites selected
During-Project:	Public meetings Hydrogeological investigation	**Construction:**	Channel works undertaken		
Re-design:	Scaled-down designs Project evaluation matrix Carry on applying for funding	**Adaptive management:**	Contingency design completed (Monitoring Year 3)		
		NERC post-project:	1998-2001	**Post-project:**	Structured monitoring programme

The QMRG project did not possess such a logical structure as it started out as a hypothetical project and hence did not develop a comprehensive suite of aims and objectives which could be worked towards Instead, very broad aims and objectives were developed at the feasibility stage Had specific aims and objectives been developed at the outset then this would have facilitated a more detailed pre-project appraisal which may have identified at an early stage likely constraints such as flood risk, thus enabling hydrological analysis to be undertaken prior to the development of the project's design This would have enabled the project's feasibility to be addressed at an early stage and hence allowed a decision whether to proceed with the project or not Early pre-project appraisal could have addressed the physical constraints and maybe led to a scaled-down vision for the site The QMRG project was pre-emptive in that it put forward a vision for the site before having fully assessed what was desired socially and what was possible both physically and practically This case study highlights the importance of undertaking a rigorous process of pre-project appraisal as depicted in Chapter 2 prior to developing a 'vision' for a site.

Although QMRG's appraisal structure did not fully facilitate the project's effective implementation, its hierarchical structure meant it was nonetheless still effective as it successfully enabled small phases of the appraisal (e g the feasibility study) to be undertaken within tight budgetary and time constraints Despite the QMRG's appraisal being undertaken in short and intense phases of activity (which caused money to be wasted) these were successful in that they enabled much detailed work to be undertaken rapidly Additionally, the second public appraisal, although not entirely inclusive, was useful as it prevented a risky project from being undertaken However, had the likely risks and problems associated with the project been identified through a detailed pre-project appraisal then this risk could have been discovered earlier

QMRG is certainly not an ideal example of how appraisals should be executed However, it is a real example of the types of constraints that projects operate under For example, statutory bodies often do not have the luxury of extensive periods of planning and pre-project appraisal as funding is often only available for usage within tight time periods These constraints can shape the structure of a project's appraisal In this instance constraints led to QMRG being undertaken in a piecemeal and reactive manner, rather than undertaking a structured and programmed approach as depicted in Chapter 2 Each potential restoration site is nested within its site specific context, and faces a range of constraints be they practical, physical or social which will shape the manner in which appraisal is undertaken The appraisal framework proposed in Chapter 2 cannot therefore be applied in an unaltered form to all restoration projects as some of its components may not be relevant to all projects or else the order of the appraisal may differ However, this framework can be used as an overall guide to project appraisal, and the principles and components depicted in this framework can be altered to suit the project in question

This case study also highlights the difficulties of balancing the input of scientific and lay knowledge in effective decision making and effective project implementation through a logically structured appraisal Whilst certain components of the QMRG appraisal structure were effective as they enabled decisions to be implemented, as a whole the structure was not an entirely effective form of appraisal The reason for this is that although QMRG was scientifically legitimised, it was not socially legitimised as decision making adopted an exclusive (scientific) as opposed to inclusive structure Hence, if science and inclusiveness are seen as the two arms of legitimate and effective decision making this case study indicates the dangers of not achieving the right balance in decision making, as decisions (made scientifically) were later refuted by the local public due to perceived flood risk This example, demonstrates the need for balance in decision making, the risks of adopting purely scientific appraisal structures and the importance of effective public appraisal

6.3.2 Evaluation of the CRRP appraisal structure

The CRRP's (see Figure 25b) appraisal exhibited the clearest and most logical structure of the three case studies This case study was the one which most resembled the framework proposed in Chapter 2, as the appraisal progressed from pre-project baseline data collection, through design, to construction, adaptive management and post-project appraisal The appraisal structure utilised on this project ensured that all constraints were identified at an early stage and borne in mind during all phases of the project's appraisal The project's design was also informed by knowledge of the river and its catchment gained through pre-project appraisal It was also ensured that all phases of the project were sufficiently budgeted for at an early stage, reserving a contingency to buffer against any unanticipated problems

Despite the clear benefits of such a logically structured appraisal, the majority of river restoration projects have less extensive resources and time available than the CRRP, hence this structure is not entirely realistic for most projects In addition, it will be seen later that despite its strong appraisal structure and greatest congruence to the appraisal structure proposed in Chapter 2, the CRRP did not legitimise its decision making as successfully as it could have done because the public appraisal was not fully inclusive and thus did not facilitate a full appraisal of stakeholder opinion.

Furthermore, the scientific legitimisation of decision making was hindered by the wide range of different disciplinary backgrounds present on the decision-making team, which although beneficial for the project's design was problematic in the sense that it was difficult to decide whose decisions should have casting vote For example, whilst designing a new meander bend, Andrew Brookes (geomorphologist) and Alastair Driver (ecologist) found it hard to agree how small the channel should be Whereas, on the one hand, Andrew was keen to use geomorphological principles (using standard equations of relationships between flow and cross-section), Alastair was, on the other hand, basing his judgement on 'gut feeling and field experience, and really knowing how channels behave in this catchment' (Alastair Driver, Interview, 21/02/2001) The final decision on what form this meander bend should take was decided between these two individuals agreeing a compromise solution which incorporated some of both of their requirements Whilst an individual's professional judgement and intuitive knowledge is invaluable it is nonetheless not an effective basis for developing best practice procedures which can be utilised on future restoration projects – which was one of the goals of the CRRP project

This case study highlights the difficulties of balancing not only scientific and public knowledge in decision making, but also balancing different types of scientific knowledge in the making of effective and legitimate decisions It shows that no matter how well structured a project's appraisal, and no matter how much time and money is available for a project, important decisions which stand to affect a project's trajectory and final design are sometimes made outside of a formalised appraisal structure, often based upon gut-feeling or personal preference, with compromises being made between personal experience and academic theory

6.3.3 Evaluation of the UKRP appraisal structure

The UKRP's appraisal structure (see Figure 25c) differed significantly to that of Queen's Mead and the Cole as it was undertaken in phases This approach was adopted as the UKRP reach was significantly larger than the other two case studies and hence could not be restored in one go Furthermore, a phased approach also reduced the likely impacts the project would have on the SSSI This project was also a chalk stream so work could only be undertaken within a six week period from the end of the fishing season through to the seasonal break of springs (September to October) when water levels were lower These factors all affected the structure of the appraisal framework utilised

When the UKRP's appraisal structure is viewed in comparison to the structure proposed in Chapter 2 it can be argued that the model proposed in Chapter 2 may be too prescriptive Although all elements of the structure are important and necessary, in some instances the early stages of pre-project appraisal could identify the need for a phased approach as utilised here For example, on the QMRG project a phased approach to the pre-project appraisal could have helped ensure that certain components of the project were undertaken before others A phase of pre-project appraisal which appraises all site constraints could have been undertaken focusing on public and hydrological appraisal This could have been followed by a phase of project design, and a further phase of construction

Phased appraisal structures can be beneficial In this instance the structure took into account the catchment context, and focused in on the prioritisation of specific reaches for restoration which would benefit the catchment as a whole This approach differs from the framework put forward in Chapter 2 and represents a pragmatic approach to the rehabilitation of priority reaches rather than the wholesale restoration of one reach This case study had clearly defined aims and objectives as espoused in the model put forward in Chapter 2 This gave the project's appraisal a sense of direction For example, specific chalk stream habitats had to be restored, hence the rehabilitation techniques selected related to the achievement of these habitat features However, this project was very specific about the components which needed restoring and perhaps could have benefited from a more broad-based form of pre-project appraisal which would have enabled the decision makers to consider a wider suite of options above and beyond the recreation of specific chalk stream habitats (e g geomorphological restoration was not considered)

Phased approaches to appraisal can facilitate a project's effective implementation and appraisal However, their effectiveness can be reduced if all phases do not fit together holistically, as they risk impacting upon one another That said, this approach was effective on the UKRP and helped implement the project within tight temporal and monetary constraints Despite the benefits of this phased approach this structure would not necessarily be effective on all restoration projects It worked in this instance due to the extent of the project and the fact that the project only stood to affect a few landowners Applied to a more densely populated urban catchment this approach may be harder to achieve, as each phase of appraisal would have to be undertaken in greater detail in order to satisfy all interested parties

6.3.4 Summary

This section has shown that the appraisal structures employed on the three case studies differed substantially:

- The QMRG project was unstructured (referred to as an *'ad hoc'* appraisal structure),
- The CRRP project was clearly and logically planned (referred to as a 'structured' appraisal), and
- The UKRP was undertaken in phases (referred to as a 'phased' appraisal structure)

All three appraisal structures successfully appraised a wide range of different components (e g ecology, geomorphology and public perceptions), and apart from the QMRG they were effective in the delivery of river restoration projects However, they also exhibited advantages and disadvantages associated with their site-specific contexts On first analysis the Cole project appeared the closest fit to the structure proposed in Chapter 2 as it was logically structured, with each component of the appraisal feeding into and benefiting the next stage. In reality, few projects have sufficient time and money available to facilitate such a detailed appraisal However, it was seen from the problems encountered in the QMRG case study that projects can benefit from spending time on Phase 1 of an appraisal – identifying problems to restore and developing clear aims and objectives for a project Without a clear idea of a project's aims and objectives it is impossible to fully assess whether a project is feasible or not Yet having too specific a set of aims and objectives (as witnessed on the UKRP) can also be a constraint as it may give the project too narrow a focus and prevent all issues which need to be considered for restoration being fully addressed (e g geomorphology)

It was demonstrated that the structure proposed in Chapter 2 cannot be simply applied in its unaltered form to a project, instead it needs to be tweaked to suit the site in question The CRRP appraisal structure showed the greatest similarity to the framework proposed in Chapter 2 and the QMRG the least similarity In Chapter 2 it was shown that it is not only the structure of the project appraisal which influences the direction a project takes but also the appraisal techniques which are utilised as the tools for executing the project The following section now evaluates the different appraisal techniques employed within the three case studies

6.4 Evaluation of the case studies' appraisal techniques

All stages of appraisal are now examined from site selection through to post-project appraisal, focusing on the breadth and depth of the techniques employed for each case study In Chapter 2 it was emphasised that a project's appraisal structure should include the following stages

- Site selection techniques – whereby sites are objectively selected,
- Pre-project appraisal
  - goal development – which is unbiased by the remit of the institution in charge of the project,
  - visioning – which is democratic, and hence not biased by a specific discipline, group of people or an individual, and
  - baseline data collection – which is broad yet also detailed,
- Geomorphological appraisal techniques – which are undertaken at both the catchment and reach scale, and are employed during the entire appraisal process to influence site selection and design,
- Public appraisal techniques – which are inclusive and bottom-up, identifying and involving all stakeholders in the entire appraisal process, and
- Post-project appraisal – which is sufficiently detailed to enable success or failure to be gauged in relation to results of pre-project appraisal of the site in relation to the aims and objectives of the project, and undertaken over a long enough period for future appraisal to be possible

All of the above should be undertaken with consideration to the catchment context in order to ensure that the project created meets the requirements of the community in which it is nested and fits in with the catchment-specific geomorphology, hydrology and ecology

6.4.1 Site selection techniques

All three of the case study sites were subjectively selected, with matrices used to a) simplify individual decision making by reducing choice to a range of lists and numbers; and b) simplify a group's collective decisions in an easy to handle quantifiable form (see Table 48) Matrices can be useful in the sense that they reduce the complexity of multiple choices, and provide a fairly rapid means for decision makers to reach consensus, whilst also acting as a practical tool for scheme comparison However, they ascribe numerical values and attempt to rank attributes which are hard to quantify Matrices also bias site selection towards selecting sites which help achieve institutional restoration goals, which can mean that they are a subjective as opposed to objective means of site selection For example, the use of a matrix on the Cole project (Section 6 2 2) assisted in the selection of one site out of a list of many However, because the matrix was so specific one could argue that by its very nature the Cole was self-selecting, and that this was not an impartial means of site selection Despite their disadvantages, matrices are effective in the sense that they enable decisions to be both made and implemented more rapidly than would otherwise be possible On the UKRP the use of a matrix helped prioritise those sites which needed restoring and also enabled decision-makers to eliminate those sites which could not be restored for practical reasons

Table 48. Site selection parameters included in the matrices for the three sites

QMRG	Agency's commitment
	Landscape quality/public perception
	Real benefits for X number of disciplines
	Public benefit
	Opportunity
	Capital contribution
	Long-term management
	Scope ranging from rehabilitation to restoration
CRRP	Achieve broad aims of river restoration
	Illustrate a wide range of reversible degradations
	Funding adequate and secure
	Owners committed to aims of restoration
	Support RRP's wider aims
	Risk of failure should be small and controllable
UKRP	Improve characteristic ecology
	Degree/extent of the works
	Visually restored chalk stream character
	Visibility and access
	Contribute to fishery
	Meet implementation and consenting requirements
	Flood risk assessment
	Cost per unit area

Ideally, site selection should commence at the catchment level, whereby potential sites for restoration are identified through a desk study and sites where restoration may not be pragmatically possible are also identified (e g lack of room, land contamination, land owner constraints) Such a systematic, as opposed to subjective, approach to site selection was not utilised on these case studies It would not have been possible on the UKRP as the Axford enquiry predefined which watercourse was to be restored On the QMRG this approach would have been beneficial as the physical constraints would have been identified at this stage On the CRRP this approach is unlikely to have been beneficial as the nature of this demonstration project meant that specific criteria had to be satisfied and hence site selection had to be more subjectively undertaken

6.4.2 Pre-project appraisal techniques

Goal development As was seen in Chapter 2, the development of appropriate goals for restoration is of vital importance for clarifying the problems which need restoring and identifying the necessary techniques for undertaking the restoration work Nationally, it was seen that 71% of appraised projects undertook some form of pre-project appraisal (Chapter 4) On the three case studies the goals selected were often influenced by the institutional backgrounds of the organisations undertaking the project For example, the CRRP's goals fitted in with the wider goals of EU Life and the RRP. Although this is not necessarily a problem, and is sometimes inevitable for gaining funding, projects would benefit if goals were developed more objectively to tackle specific problems which relate to the catchment context This would have legitimised the decision-making process and enhanced its effectiveness, ensuring that goals were developed in order to restore specific problems (as was seen on the UKRP) On the QMRG, project goals were not specific enough and hence the project lacked a distinct focus Despite the fact that goals were not developed as objectively and in such detail as espoused in Chapter 2, the manner in which goals were developed on these three projects still enabled the decisions made to be implemented Being tied to institutional goals meant that the process of gaining financial backing and getting the project started occurred more rapidly than would otherwise have been possible So, although the development of project goals in its purest sense should be driven by the problems which need restoring it is also important to be realistic and tailor additional goals to satisfy financial donors or other organisations involved in the project. In this sense a tiering of goals could be espoused, whereby certain goals are identified as imperative for the project's environmental sustainability, whereas additional goals are developed to satisfy funders without impinging upon the project's sustainability

Visioning All the QMRG and CRRP projects' 'visioning' was used as a preliminary form of appraisal. In all three cases it was seen that visioning as a tool for gaining support and input into the project was highly beneficial as it enabled

- Non-expert groups to gain a visual impression of what restoration could offer a site,
- Decision makers to identify components they wanted to see included in a project, and
- Consensus to be reached on project designs and techniques to be employed

Despite these benefits there is a risk that visioning can inadvertently lead to bias or coercion as, in the absence of alternatives, the most visually attractive options are likely to be given preference by members of the public If clear thought is not given to how visioning should be undertaken there is a risk that it could lead to reduced legitimacy in decision making For example, in the case of QMRG, visioning was used to seek public consensus for the process of restoration without facilitating public input (and was therefore not inclusive) Had more appropriate public input been sought then a very different result might have emerged as it is likely they would have identified the potential flood risk at an earlier stage. There is thus a need for visioning to be more inclusive in order to enable the development of designs which are sustainable both socially and environmentally, as a more objective usage of visioning could have facilitated a more democratic decision-making process One of the problems with QMRG was that the public was presented with a limited choice of three visions, when a more appropriate form of appraisal would have been to get them to construct their own visions

On the CRRP visioning was not used for public appraisal but rather to gather the visions of the two separate management groups in order to develop consensus between decision makers on how the whole site should be restored Martin Janes described the visioning phase of the project appraisal as follows

> 'Basically, everyone was given the opportunity to go and have a think We just gave everyone a big A1 plan of the site, and said go away and mark on what you'd like to see So from a fisheries point of view the fisheries person went off and thought 'oh well this is a bit of naff habitat here, so we'd like to put a load of gravel in ' People like Andrew Brookes and Dave Sear went away and started drawing all over with anastomosing channels Others were incorporating in floodplain elements Jeremy wanted wetland features. Others wanted reedbeds. From this we ended up with about four options of what we could do, from going back five thousand years to something a bit more realistic' (Martin Janes, Interview, 08/05/2001)

It was indicated that whilst this approach was useful in drawing together the visions of a large number of people it was, however, difficult to resolve the different requirements of decision makers from different scientific backgrounds This agrees with the research of Shipley (2002 18), who suggests that a common vision may not be possible in a complex community However, whilst visioning can affect the democracy of the decision-making process and hence reduce its effectiveness it can facilitate the portrayal of a group or individual's aspirations for a site, and can assist in gaining support for a project's implementation However, in order to generate appropriate visions for a site, all stakeholder groups need to become more inclusively involved in this visioning process from a project's outset through to completion

Baseline data collection The collection of pre-project baseline data is an important component of the appraisal process as these data can be used to inform a project's design and are necessary to gauge a project's success during post-project appraisal On all three projects a wide range and depth of baseline data were collected At Queen's Mead this phase of the appraisal process did not have a clear structure and it was not undertaken as a means of facilitating future post-project appraisal, but was instead undertaken to inform the project's design Had baseline data collection been undertaken as part of a coherent framework of appraisal then it would have removed some of the circularity evident in this project

On the Cole a great deal of pre-project baseline data were collected for one year prior to project commencement Here, the wide range of ecological, hydrological and historical data collected assisted in the project's design as it identified features which needed to be kept, and features which existed in the past which could be recreated. The baseline data collected were also so extensive as to enable future researchers to return at any point in the future and carry out a post-project appraisal of a wide range of parameters However, in less well funded projects there is a danger in collecting too much data which is never used and hence time and money is wasted Pre-project data collection needs to form part of a clearly thought out programme of works to ensure that the data collected are useful and meaningful

In situations where projects do not have extensive funds available for post-project appraisal then the UKRP's model of strategic baseline data collection may be a realistic alternative This approach allowed enough data to be collected to facilitate the project's design, and focused in on specific indicators of change which would be able to demonstrate the project's physical achievement of its aims and objectives Although this may restrict the scope of future post-project appraisals, in a pragmatic sense it will enable TW to prove or disprove to all stakeholders that their money was well spent and the project's aims achieved

Baseline data collection needs to be sufficiently detailed to aid a project's design and to facilitate post-project appraisal to assess whether a project's aims and objectives have been achieved If the data collected is not detailed enough then it risks reducing the effectiveness of the project's design, its implementation and its ability to undertake post-project appraisal with overall impacts on a project's potential success

6.4.3 Geomorphological appraisal techniques

The importance of geomorphology in river restoration has been emphasised throughout this thesis The three case studies were selected because their appraisal was deemed to have been rigorous However, despite this none of them had had very detailed geomorphological input On the QMRG project and the UKRP the role of geomorphology was limited, and on the CRRP geomorphological appraisal was detailed at the post-project stage but minimal in the formative design stages. These trends fit with those identified in Chapter 4 where it was seen that ecology and fisheries are the main focus of restoration projects in this region, and, nationally, geomorphological restoration was primarily seen to be incorporated into flood defence projects (Chapter 4)

On the QMRG site, although it is acknowledged that restoration of past geomorphological features may no longer be appropriate for the catchment, the project's designs could nonetheless have benefited from geomorphological input which would have helped in understanding the project's constraints, and assisting in the design of the reach's physical habitat features A geomorphological understanding of how a river functions can help to inform a restoration project's design by giving insight into its sensitivity to change and the process-form relationships that might be appropriate for a river in the future once restored The geomorphological aim of the QMRG project was to produce a self-adjusting, self-cleansing channel, which produces its own features such as pools and riffles without maintenance The new channel was designed to emulate the river's 1863 planform, yet no consideration was given as to whether this was a viable option for the catchment in its present context The final design for the channel may have emulated the river's past planform yet was created in such a manner that it could not self-adjust or self-cleanse as it was decided to maintain the existing concrete channel and to construct the new channel over the top of this structure with a sweetening flow This project could have benefited from a Catchment Baseline Survey followed by a fluvial audit in order to help develop a vision for the site which would be sustainable for the catchment in the present day. Rather than trying to mimic a past channel form which would no longer be sustainable, a scaled-down vision for the reach could have been developed which would enhance the watercourse and its floodplain without increasing flood risk to people and property Whilst the QMRG project sought to emulate a past channel form there was little geomorphological input to the project This may be because the project was designed and guided firstly by a landscape architect and secondly by an engineer Greater involvement of geomorphologists throughout may have led to a more geomorphologically sound design

On the Cole, geomorphological input into the project was not witnessed throughout the project's entirety At the pre-project stage geomorphology guided the designs for the channel's cross-sections, with the greatest depth of geomorphological appraisal coming at the post-project stage when the project's success was evaluated The channel's design could have emanated from a thorough geomorphological appraisal commencing at the catchment scale and down-scaling to the reach level, whereby the cross-sections and planform were designed so as to be suitable to the catchment in its present context and to enable processes of self-adjustment, erosion and deposition Whilst a geomorphologist was involved at the visioning stage of the project the designs for the site had to incorporate the views of a range of disciplines and hence did not have geomorphology as its foundation The post-project appraisal of the CRRP was undertaken in detail because it formed part of Alison Brigg's PhD research This research later led on to more detailed post-project appraisal work supported by NERC Connect B grants.

A lack of geomorphological input on the UKRP may have been related to the fact that this chalk stream rehabilitation did not aim to restore past geomorphological features but instead aimed to rehabilitate protected chalk stream features According to Nick Lutt (Thames Water, Personal communication, 06/09/2002) the UKRP focused on the production of a better hydromorphology than existed pre-restoration, allowing the river to adjust and modify itself This would, in turn, enhance its ecology and long-term sustainability as it would give the river sufficient space on the floodplain to self-adjust Thus on this project greater focus has been placed on ecological and hydrological restoration over geomorphological restoration In addition, the project was guided by Nigel Holmes, an ecologist, and Kevin Patrick, a landscape architect Had the project been managed by geomorphologists then greater geomorphological input may have been witnessed

All three projects could have benefited from greater geomorphological input throughout Detailed geomorphological appraisal first undertaken at the catchment scale then focussing down to the reach level would have aided site selection, project design and implementation It would have ensured that sites for restoration were selected to benefit the catchment as a whole, and that a new channel's morphology is sustainable geomorphologically at the reach and catchment scale, and will not have negative impacts downstream The depth of geomorphological appraisal required depends upon the nature of the site as, according to Andrew Brookes (Cole working group meeting, 24/10/1994), river restoration needs to be imaginative to cope with modern problems Thus, although emulation of a pre-disturbance meander pattern may no longer be appropriate for the site's present context, geomorphology can assist in the development of designs which are suitable for the reach in its contemporary context, and can help to minimise potentially negative impacts of a project These trends were mirrored in the national investigation where the Thames region was seen to have undertaken the most geomorphological appraisals, yet the nature and depth of these appraisals was limited (see Chapter 4, Section 4) This section has highlighted the wider need for river restoration practitioners to be trained in the science of geomorphology

6.4.4 Public appraisal techniques

The importance of public appraisal was demonstrated in Chapters 2 and 4 (Section 4 2 5) where the Thames region was identified as one of the main regions where the public had participated in restoration projects Across these three case studies the manner in which the different stakeholder groups were appraised varied significantly as the composition of the group entitled 'the public' differed greatly from site to site In addition, on all three sites public appraisal was undertaken for different reasons, reflecting the different compositions of these groups and the different reasons for appraising public opinion in the first instance

On the Queen's Mead project, the public meetings were deliberately engineered so as to avoid confrontation and a free-for-all plenary (Maureen Fordham, Interview, 31/01/2001) They took place at a stage in the project when decisions had already been made by the experts and the designs drawn-up This approach did not give a voice to those strongly against the project, nor did it give the public a chance to inform the design As a result, several years passed before managers became aware of the basement flooding issue. The QMRG's public appraisal was not fully inclusive and favoured expert knowledge rather than giving a strong voice to the public

According to Richard Vivash (Interview, 13/03/2001) on the CRRP, involving the tenant farmers in decision making was seen as important 'because at the end of the day it was the farmers who had to live with the changes and farming still had to be viable ' Although decision making on the Cole gained a greater balance between science and inclusiveness than on the QMRG it was still nonetheless not wholly inclusive as farmers and the public did not have many opportunities for input into the project, as public appraisal was not extensive More formal appraisal of the tenant farmers' perceptions and pre-project appraisal of public opinion may have benefited the project's design, as according to Creighton (1992 4) and Jackson (2001. 136), involving people in decision making reduces conflict, and increases their trust in decision makers Early on in the project more inclusive consultation would also have provided opportunity for managers on the CRRP to forewarn the public that the river would take a while to adjust, stabilise and revegetate itself, thus preventing people from being shocked that the completed project looked 'raw '

The UKRP demonstrated that public consultation could also benefit from the presence of a trusted figure – for example a community liaison officer or a site officer – whose presence on site on a regular basis can help assuage stakeholders' fears and understand their needs On the UKRP, Nigel Holmes' presence helped explain the benefits of the project to the stakeholders in a very visual and graphic sense (Mike Crafer, Interview, 18/07/01) This approach suited the UKRP and was logistically possible because landowners were not numerous Despite the success of this approach the public's participation was still not fully inclusive as their appraisal and the depth of their input was still fundamentally controlled by Nigel However, ultimate power rested with the landowners as without their support the project would not have been possible (hence the importance of the role of partnership)

Overall, in each of the case studies the public appraisal techniques employed reduced the legitimacy of the decision-making process in the sense that they reduced democracy. On the Cole and Kennet the nature of the public appraisal facilitated effective decision-making, enabling decisions to be implemented Having said this, both projects highlighted the risks of undertaking public appraisals if their sole purpose is to legitimise decision which have already been made The QMRG indicates even more sharply the risks of appraising public opinion at a late stage in a project Although, public participation in decision making is important it is also equally important to ensure that too much participation does not undermine the need for science in the creation of a legitimate and effective project. As full public participation and limited scientific input would be likely to lead to the creation of a project which is unsustainable

6.4.5 Post-project appraisal techniques

In Chapter 4 (Section 4 3) it was seen that, nationally, 66% of appraised projects undertook some form of post-project appraisal Including post-project appraisal enables researchers to assess whether aims and objectives were achieved and hence enables one to establish whether a project was successful or not Thus, if aims failed then they can be returned to through a phase of adaptive management and changes made to ensure a project's long-term sustainability At the time of writing the CRRP case study was the only project out of the three case studies to have undertaken post-project appraisal, as the QMRG has not yet gone ahead and the UKRP has only recently been completed Post-project appraisal has the potential to act as a gauge to the overall effectiveness of the decision-making process, thus it should be sufficiently detailed in order to gauge the legitimacy of decisions made and how well these decision were implemented On the CRRP, the eco-geomorphological post-project appraisal was extremely beneficial in that it indicated to the river restoration community that on river and floodplain restoration projects often the greatest biodiversity gains are achieved not in the river itself but in the wetland habitats created adjacent to the watercourse

6.4.6 Summary

In Chapter 5 it was shown that in order to undertake a project successfully decision making needed to be effective, inclusive and legitimate These concepts were also applied in this chapter and in addition it is suggested here that to be effective appraisal must.

- Be catchment-based;
- Be included at all stages from project inception through to post-project appraisal,
- Utilise appropriate appraisal and restoration techniques to ensure that decisions made are inclusive and legitimate through
    - democratic public participation in appraisal, and
    - in-depth geomorphological appraisal

This section summarises Section 6 4 comparing the three projects to the proposed appraisal framework in Chapter 2 and applying their achievement of the above criteria

Site selection – The appraisal framework proposed in Chapter 2 identified a need for objective site selection within a catchment context Evaluation of the case studies appraisal techniques showed that site selection was primarily subjective and only QMRG was selected within the catchment context However, site selection was seen to be driven by institutional goals, and was often necessary to gain funding

Pre-project appraisal – The next stage of project appraisal according to the framework proposed in Chapter 2 is the development of goals to help guide the vision during restoration planning Clearly defined goals are also needed in order to undertake a post-project appraisal in order to assess whether goals have been achieved In all three cases goal development was subjective and often based on the remit of the institution in charge of the project This is not surprising as different funding bodies have different reasons for injecting money into a project and hence have different aspirations for a project Furthermore, it is not always possible to develop goals entirely objectively as different decision makers have different goals by virtue of their different backgrounds and different sites will have different goals depending upon the nature of stakeholder requirements

Geomorphological appraisal – The importance of including geomorphological appraisal in projects was highlighted in Chapter 2 Geomorphological techniques were not employed at all stages of the appraisal process on any of the projects Even on the CRRP, which had the strongest geomorphological influence, the project could have benefited from a greater depth of pre-project geomorphological input

Public appraisal – Neither of the three projects undertook public appraisal in greater depth The UKRP had a smaller range of stakeholders to work with and was effective in that it engaged all the landowners affected by the project in the appraisal However, there was little indication that the landowners were engaged in the design of the projects On the QMRG, had the public become engaged at an early stage in the project's design then the flood risk constraints may have been discovered earlier and a design created to circumvent this constraint On the CRRP, the tenant farmers were consulted about the project However, because the land was owned by the National Trust who were in support of the project the farmers had little input into the project's design Involvement of all stakeholder groups in the visioning process may have been beneficial on all three sites.

Post-project appraisal had at this stage only been undertaken on the Cole and was sufficiently detailed to enable success or failure to be gauged in relation to the site's eco-geomorphological composition following construction

It was seen that the appraisal techniques employed were not utilised in the greatest depth required for effective project appraisal (as discussed in Chapter 2), despite this they did not prevent decisions from being effectively implemented within given temporal and financial constraints However, decisions could have been legitimised to a greater extent by use of more extensive and objective appraisal techniques.

6.5 Conclusion

This chapter has shown that like the decision-making structures discussed in the previous chapter, the appraisal structures employed on the three case studies differed substantially (Section 6 2), with the QMRG being classed as *'ad hoc'*, the CRRP as 'structured' and the UKRP as 'phased '

The CRRP structure showed the greatest similarity to the structure put forward in Chapter 2 and was deemed to be the most successful as it prevented money and time from being wasted as its clear structure prevented circularity from occurring However, it was suggested that this structure may not be possible on projects which have greater financial and temporal constraints, though it was acknowledged that it could act as a blueprint for future projects

This chapter has examined in detail three case study sites which were selected because they were deemed to have undertaken detailed project appraisals It was seen that despite the perceived depth of project appraisal on these sites that the appraisal techniques utilised favoured subjective as opposed to objective approaches to site selection and goal development Also visioning, geomorphological-, public- and post-project appraisal could have been undertaken with greater breadth and depth on all sites, with more extensive inclusion and appraisal of lay knowledges However, it is important to realise that each case study demonstrated strengths in some components of their appraisals and weaknesses in other areas as is now discussed

A project's decision-making structure should be kept as simple as is possible and should aim to be democratic giving equal voice to all involved On the CRRP the decision-making structure included a wide range of individuals Whilst beneficial in some senses (as the project incorporated a range of disciplines) it can lead to interdisciplinary disagreements For example, there was disagreement between two scientists from different disciplines as to what a meander should look like. On the UKRP the decision-making structure was composed of fewer individuals This was effective as it enabled decisions to be made faster, however, it may have ultimately led to final decisions being influenced to a greater extent by the two key project managers It can hence be seen that if decision-making structures are to be effective, inclusive and legitimate, they need to be relatively simply structured yet also inclusive of all stakeholders Therefore, this necessitates a truly multidisciplinary team in order to gain input from a wide range of disciplines and therefore giving equal voices to all stakeholders

With regards to the appraisal structure, it is necessary to gain a balance between arrangements which are structured yet are also flexible. On the QMRG, the lack of a firm appraisal structure led to both money and time being wasted with constraints being identified too late on Whilst this structure was effective in that it enabled some appraisal to occur, it was ineffective in that the project was never undertaken On the CRRP, the appraisal structure was pre-designed and whilst effective in that it enabled a project to be designed and implemented effectively it was also somewhat ineffective in that some important decisions (e g the additional meander) were still made relatively rapidly without full consensus of all stakeholders The UKRP demonstrated the benefits of a phased approach to appraisal. This was a concept which had not been considered in the appraisal framework in Chapter 2 and is beneficial on large projects which are composed of multiple sites However, it is important that all sites, when restored, work together It is therefore necessary to have a vision as to how all the reaches function as a whole In this case a demonstration project was seen to be a very useful visual tool to gain support and understanding from stakeholder groups

Aside from the CRRP little geomorphological input was evident in the other two case studies In Chapter 2 the importance of geomorphology in project design was emphasised and the benefits of incorporating geomorphology in a project were demonstrated in the CRRP whereby the biological diversity of floodplain was seen to be richer following restoration Consideration of the catchment's geomorphological structure and performance is important in the design of a reach which will function sustainably. One of the goals of the QMRG was to create a reach which mimicked the river's past rural form, however, little thought was given as to whether that was sustainable in the catchment's present urban form This chapter therefore reiterates the points made in Chapter 2, emphasising a greater need for geomorphology in a project's appraisal and design

With regards to public appraisal, the QMRG case has indicated that the timing of public appraisal is of crucial importance If undertaken too late then it may prevent a project from going ahead Therefore, the public should be engaged in the project right from the start, as they may possess important lay knowledge which is vital to the project. When designing a project it is therefore important to strike a balance which combines both 'expert' and 'lay' knowledge in the creation of a project which benefits the environment yet also incorporates the needs of the local community In order to achieve this a grassroots approach to appraisal is desirable, with information flowing freely between decision makers and stakeholders On the UKRP it was demonstrated that the presence of a trusted figure or a public liaison officer may be beneficial, as this will help ensure that all members of the public are included in the project This person can also act as a link between the local community and the decision makers, helping to explain scientific decisions in a manner palatable to non-scientific communities, whilst also conveying lay knowledge back to the decision makers It has been seen in this chapter that differences of opinion exist not only between lay and expert communities but also between different types of expert who practice different branches of science

The UKRP demonstrated the importance of adopting a targeted approach to post-project appraisal which focuses on appraisal of specific features This is beneficial as it ensures that money and time is not wasted if resources are limited However, this targeted approach may prevent interesting features that emerge from a project from being appraised, therefore, it is important to ensure that the programme of post-project appraisal is sufficiently detailed to allow the original aims and objectives to be tested There is, however, a fine line to be trod as the CRRP collected such a wide range of date and only a small amount of this has been used during post-project appraisal

The appraisal framework put forward in Chapter 2 presents an ideal version of how project appraisal could be undertaken if time and money constraints did not exist Whilst none of the case studies discussed followed the same format as this framework they all included some components of this framework Chapters 5 and 6 have shown how varied projects can be in terms of who makes decisions and how they make them, and the types of constraints exhibited.

Due to these differences it would be impossible to utilise one appraisal framework as a template for all projects Instead, the framework proposed in Chapter 2 needs to be utilised in the context of each individual project and adjusted to suit the site in question Chapter 8 returns to the appraisal framework put forward in Chapter 2 proposing revisions in light of the findings of this research

The next chapter considers the influence of the decision-making structures discussed in Chapter 5 on these appraisal structures. It will be shown that it is the combination of the appraisal and decision-making structures which affects a project's final design and implementation

Chapter 7. Thames Region Investigation: evaluating impacts of decision-making and appraisal structures upon river restoration project design and implementation

7.1 Introduction

In Chapter 4 it was demonstrated that appraisals of river restoration projects are rarely undertaken in much detail There are, however, exceptions and Chapters 5 and 6 explored three case study restoration projects which were seen to have been designed and executed within detailed frameworks of appraisal It was suggested in Chapter 5 that the structure of the project appraisal and the composition of the decision-making structure both influence a project's final design and implementation Therefore, the appraisal structures utilised will have a strong bearing on how effectively decisions are made and implemented Similarly, the structure and composition of decision making will affect what components are appraised and how this appraisal is undertaken This influences both how effectively decisions are implemented, and how inclusive and legitimate the decision-making process is It was argued that for decision making to be effective, and to enable projects to be implemented inclusively and legitimately, that stakeholder groups need to be incorporated into the decision-making process

In this chapter the manner in which different decision-making structures shape the appraisal processes is evaluated The key questions are

- How does the structure and composition of decision making affect the nature of the appraisal undertaken?
- How does the appraisal structure utilised affect the process of decision making?
- How do the decision-making and appraisal frameworks employed on projects affect their long-term success? and
- How do organisational settings within which projects are undertaken influence the activities undertaken by stakeholders? (Rydin and Greig, 1995 273)

Prior to undertaking this evaluation, the next section (7 2) explores the broader debates surrounding the input of scientific expertise in environmental decision making and river restoration These issues were highlighted for attention in Chapter 5, where the difficulties of achieving an adequate balance between expert and lay knowledge in environmental decision making was indicated This section also explores the effects of specific institutional backgrounds on the environmental management activities undertaken Section 7 3 then analyses the effects of decision-making structures and appraisal structures upon one another, focusing on the three case studies in turn Section 7 4 concludes the chapter highlighting the factors (e g different disciplinary backgrounds of decision makers and financial constraints) which influence the manner in which both project appraisal is structured and decision making undertaken These factors are shown to ultimately affect a project's final design and the manner in which it is implemented

7.2 The role of science in river restoration

In Chapter 5 it was argued that two of the key qualities of effective decision making were inclusiveness and legitimacy In river restoration projects decision making is ideally based upon an equitable and inclusive sharing of power between stakeholder groups, culminating (via appraisal) in the development (through consensus) of effective decisions and decision-making plans It was shown that decisions can be legitimised through science and through the inclusive participation of stakeholder groups However, both modes of legitimacy are problematic as neither one alone facilitates the development of truly effective and sustainable projects, a balance is thus needed in order to be both inclusive and scientific

In the context of the three river restoration case studies the role of science is clear, as the scientific backgrounds of the decision makers, and the organisations within which these decision makers operate, influence both the nature of and the manner in which decisions are made These facts stand to influence the legitimacy of the decision-making process and the effective implementation of potentially sustainable projects, as legitimate decision making also requires the input of non-scientific knowledge However, the roles that science and the public play in producing effective, inclusive and legitimate decisions varies from project to project There is, therefore, a need to negotiate the relationship between expert scientific opinion and lay or public opinion when they differ This point is especially relevant to the field of river restoration, as the achievement of a project which is environmentally sustainable at the reach and catchment level could be negated if a scheme is not accepted locally Having said this, Rydin and Pennington (2000 153) also warn that over-expanding public participation is not always the best option In the case of river restoration this statement may also apply, as complete public control may stand to decrease a project's sustainability due to a lack of knowledge of the geomorphological and hydrological processes which need to be understood for developing projects which function physically yet do not exacerbate flood risk

With these points in mind, increasing levels of public participation in decision making should not seek to reduce scientific input because science is an important means of arriving at and legitimising environmental decisions It is thus important to achieve a sufficient balance between expert and lay knowledge if a project is to be effective and decision making legitimate and inclusive This need for balance is further reiterated by Paehlke (2002 30) who suggests that although science is essential in environmental policy and decision making, it is not always sufficient for making appropriate and correct decisions Thus, in this vein, effective decision making is seen here to involve the use of compromise in the achievement of the most environmentally and socially sustainable solutions without risk to human well-being In striving to achieve this balance there is, moreover, a greater need for dialogue between the scientists and the public in order to enable the public to comprehend and learn from scientists, and for scientists to learn from and understand the public's needs

If stakeholder involvement is seen to be key in effective and inclusive decision making, then it makes sense that stakeholder groups need to be both fully identified (Greenwood, 2001 32, Harvey and Schaefer, 2001 243) and effectively appraised if their views are to influence the decision-making process The usage of more participatory approaches – for example, 'planning for real' and citizens' juries – is now advocated as they represent more inclusive forms of decision making which reduce the risk of alienating lay communities with overly scientific information (Tunstall *et al*, 2000a) A key aspect of this is the communication of science and technology to non-scientific communities or individuals If public appraisal is to be undertaken effectively it needs to give consideration to

- Who counts as a stakeholder or as 'the public',
- The weighting of public versus expert opinion in decision making,
- The timing of public participation, and
- The best techniques for appraising public perceptions

The following section will examine the influence of decision-making structures on appraisal and of appraisal on decision making This is achieved through more detailed usage of the qualitative data gained through the interviewing of decision makers This will explore the differences of opinion between decision makers, looking at how those involved in the decision-making process influence a project's final design and trajectory The effect that institutional goals have on the decisions that are made and on the behaviour of decision makers is also examined to see how far they influence a project's appraisal It is suggested that an institution or organisation's background will influence decision making through the specification of certain parameters which must be included or excluded from a project within its appraisal and its final design. For example, on the Cole project the EU Life fund specified that the project should restore river-floodplain interactions This, therefore, guided the final design of the project Alongside this examination of organisational goals, the role of the expert will also be explored to see how the case studies incorporated scientific and non-scientific knowledge in decision making and appraisal, and how decision makers sought to strike a balance when trying to legitimise a project scientifically and inclusively Differences of opinion between different scientists are explored, looking at how disagreements are resolved during project design between conflicting brands of science Finally, the manner in which stakeholder groups were mobilised and involved in the appraisal and decision-making processes is examined, considering how effective and inclusive their involvement was and how it influenced the project's trajectory.

7.3 Impacts of decision making and appraisal structures upon one another

In Chapter 5 (Section 5 4) it was demonstrated that decision making on the three case studies was undertaken through use of three different decision-making structures

- Hierarchical decision-making structure (QMRG),
- Bilateral decision-making structure (CRRP), and
- Partnership-based decision-making structure (UKRP)

Chapter 6 (Section 6 3) showed that the appraisal structures utilised on the three projects differed substantially and were defined as

- *Ad hoc* (QMRG),
- Structured (CRRP), and
- Phased (UKRP)

Taken together, Chapters 5-6 have shown in various ways that the different decision makers and decision-making structures employed on these projects affected the nature of the appraisals undertaken and the appraisal techniques employed Similarly, it was also shown that the appraisal structures utilised on these projects shaped how and when decisions were made and the timing of the involvement of certain decision makers in a project This chapter explores the relationships in more detail, taking each case study in turn In Chapter 5 it was indicated that for projects to be undertaken successfully then decision making and appraisal must be effective, inclusive and legitimate These three criteria are returned to throughout this chapter to assist in the evaluation of the three case study sites

7.3.1 Hierarchical decision-making structures and *ad hoc* appraisals

Project appraisal was defined as *ad hoc* on the QMRG project and its trajectory was guided by a hierarchical decision-making structure Although the NRA and London Borough of Bromley were partners on this project, the NRA was seen to guide single handed the project's appraisal and trajectory Contact with London Borough of Bromley was mainly limited to financial negotiations, and although London Borough of Bromley's opinions were sought on vision plans this usually occurred after such plans had already been independently drawn up by the NRA

Hierarchical structures affect the nature of the appraisal through the deployment of top-down approaches which can use the different phases of appraisal as a means of legitimising decisions These structures favour the use of expert over lay knowledge, and, although not entirely inclusive, they are successful in that they do enable appraisal to happen and are hence effective in enabling decisions to be made In the case of the QMRG project the resulting appraisal was *ad hoc* Although this approach to appraisal is not advocated in the literature, in this instance it did enable appraisal to be undertaken within the tight temporal and financial constraints of the project

(i) Influence of institutional goals on project trajectory

It is important to realise that the nature of the NRA's objectives for this project – geomorphological, ecological, visual and access – may have in part contributed to its eventual failure The NRA envisaged the QMRG reach not only as an aesthetic and recreational resource for the local community, but they also wished to emulate nature in a highly unnatural setting by recreating a self-adjusting and self-cleansing channel This vision may not have been sustainable within this catchment due to its high level of channelisation Thus, geomorphological restoration at Queen's Mead would have had limited benefit as it is likely that a newly constructed morphology would be rapidly washed away since existing sediment sources would not be sufficient to maintain it In this sense, the nature of the expert-led hierarchical decision-making structure did not have a positive influence on the appraisal as it created an unrealistic vision

This point indicates the fact that the range of different disciplines included in a decision-making structure is very important in the development of effective and sustainable solutions which are suited to the river and catchment in question Had greater geomorphological input into decision making been present, then a greater depth of geomorphological appraisal would have been ensured Having said this, the broad and ambitious nature of the NRA's objectives were beneficial in the sense that they aimed to create as natural looking a reach as possible in a highly unnatural location, thus setting high visual standards for the project's design The range of experts present on the QMRG decision-making team did not facilitate the most sustainable design However, they did facilitate the creation of an imaginative design on a highly constrained site

The individuals who form part of a decision-making structure bring their own perceptions and ideas of how they wish to see the individual project undertaken These ideas can emanate from their institution, which may have a specific remit regarding restoration, or it may come from their disciplinary background In selecting the members of a decision-making team it is therefore important to select a wide range of people from different backgrounds It is also important to balance the requirements and ideas of the different team members as some decision makers within the team may be more vocal or persuasive than others and may thus be more capable of convincing other team members of the validity of their ideas This fact is especially pertinent in a hierarchical decision-making structure whereby decision making is influenced by those at the top of the hierarchy In order to be effective, hierarchical decision making needs to be more inclusive in terms of appraising a range of people's opinions in order to ensure that a project is designed not solely based upon the decision-making team's disciplinary background

(ii) The role of experts

A large component of the project appraisal on the QMRG was undertaken by environmental consultants Although located third in the decision-making hierarchy, they did have quite strong powers of influence as providers of 'scientific fact' which was in turn used by the NRA to justify actions taken (see Chapter 5) This demonstrates science's political credibility and potency (Paehlke, 2002 35) For example, the externally commissioned river landscape assessment was used by the NRA to justify the selection of QMRG as a site for restoration Chris Blanford Associates were also commissioned to calculate the feasibility of the NRA's design options, and Project Engineering Services were relied upon to calculate flood risk By externalising these elements of decision making and appraisal, the NRA handed over a certain amount of its power to consultancies, relying on their capacity as 'experts' or 'scientists' to make very important project-shaping decisions This diffusion of power, albeit short term, was not conferred on non-expert stakeholders

Although influential these external consultants were also restricted by the visions and requirements of the decision makers located higher up the decision-making hierarchy For example, Andy Pepper describes how the QMRG project suddenly gained funding which needed to be spent within a short window of time, and he was employed as a consultant to produce suitable designs In describing his involvement he stated that

> 'They [the NRA] wanted the engineering details of ideas that had been sketched out by Andrew Brookes as a geomorphologist and Kevin Patrick as a landscape architect I was trying to put into engineering practicalities what other people such as geomorphologists had come to us with, what they reckoned would be a sustainable size and shape of river In other words he [Andrew Brookes] came up with some meanders which he thought would be appropriate so we tried to build them in, and the landscape architect's [Kevin Patrick] idea of what was needed' (Andy Pepper, Interview, 25/10/2000).

This statement indicates the role of the consultant in project decision making for the QMRG, whereby they were employed to legitimise the decisions made Maureen Fordham, the public perception consultant for QMRG, referred to her role as a consultant as being akin to a 'small cog in the wheel' whereby decisions were made by the decision makers not the consultants In the case of Andy Pepper, his role was to utilise the channel designs made by the decision makers and retrofit a suitable channel size and shape which would in turn be hydrologically acceptable (i e would not increase flood risk)

The QMRG is an example of the power of science in decision making and appraisal, whereby science is used to legitimise and to appraise decisions in order to facilitate implementation In this case study science was effective to a certain degree However, the public's desire for scientific certainty during the public meeting indicated the power alternative knowledges can also have on a project, with public concerns over flooding causing the project to be stalled Hierarchical decision making composed of experts can thus influence appraisal in that it can minimise the opportunity for the public to become involved in the project as decisions are made primarily by those located at the top of the decision-making hierarchy, only drawing on public opinion at stages when their approval is required This affects the project's effective implementation as it reduces democracy through the exclusion of certain voices, yet legitimises decisions through the use of science

Science can be an effective means of legitimising decisions, however, it is not entirely democratic and inclusive as it excludes those who do not possess scientific knowledge A further risk of utilising science as the sole mode of decision legitimisation is the risk that experts may disagree through virtue of their different disciplinary backgrounds This potential risk thus requires an ability to balance decision making between scientists and also between scientists and the public

(iii) Stakeholder mobilisation

On the QMRG, uneven power relations were evident throughout the entirety of the project, as during all stages of the appraisal process the NRA sought approval from stakeholders on decisions that they had already made For example, during the preliminary public perception work undertaken by FHRC, public opinion was appraised purely on aesthetic grounds, using a site vision plan which had been drawn up without input from any local user groups. This expert-led approach to public appraisal facilitated overwhelming support for river restoration at this site This support was, however, in effect produced by the method used to appraise public perceptions Using the expert's vision (the landscape architect's depiction) as the sole appraisal tool automatically shaped a favourable public response In the absence of hard fact the public were reduced to making aesthetic judgements based on their cultural pre-conditioning of how a river 'should' look Support for the restoration option was thus unsurprising given that the public were asked to choose between the existing sterile concrete river environment and a more natural alternative

Although visioning can be a useful tool for conveying information of a technical and scientific nature to stakeholder groups, it can also bias decision-making outcomes as it does not offer stakeholders the chance to feed-in their ideas, their local knowledge and their concerns This fact was especially relevant at Queen's Mead, where although the public embraced the concept of restoration in principle, in practice they possessed very real flood risk concerns which were not identified during this stage of the appraisal A more democratic and participatory decision-making process would have led to the recognition of the issue of flood risk at an earlier stage, enabling the design's scope to be tailored more realistically to incorporate these constraints For stakeholder involvement to be effective it was argued in Section 7 2 that all stakeholder groups need to be fully identified and included in participatory appraisal, whereas at the QMRG only small groups were involved in the public appraisal Stakeholder mobilisation on the QMRG resulted from its hierarchical structure, whereby power rested in the hands of the experts, and appraisals were undertaken quickly to facilitate the project's rapid implementation given the temporal and financial constraints

Gaining the right balance in decision making and stakeholder mobilisation is a complicated process During an interview with Maureen Fordham the difficulties of appraising public opinion and engaging people actively in decision making was highlighted On the one hand, Maureen asked whether what the public thinks 'looks nice' is worth considering over the conservation of say a plant or an animal This is an important question about what constitutes the correct balance between scientific and lay knowledge in the creation of a project which is environmentally and socially sustainable When questioned about how project appraisal and decision making should be undertaken, Maureen Fordham espoused a grassroots approach stating that

> 'Ideally we would be much more involved at the grassroots level, and create a community project where it matters From the very early stage, we should incorporate all the needs of the group, find out all their concerns, so that the project becomes theirs, of the community That is actually a very tricky balance to make, it is very expensive, but that would be the ideal way' (Maureen Fordham, Interview, 31/01/01)

Gaining a balance in decision making is hard to achieve Giving too much decision-making power to lay groups may lead to the creation of a project which is not environmentally sustainable However, if too little decision making power is conferred to stakeholder groups then, as Maureen Fordham warns, there is a danger of environmental managers imposing themselves as the 'expert, when in reality it's the people whose neighbourhood it occurs in who are the experts' (Maureen Fordham, Interview, 31/01/01)

When asked the same question as Maureen about his preferred mode of decision making on a project, Andy Pepper put forward the following approach

> 'I think that the ideal thing which I have done on another projects is to say hang on what do we really want here? What are the constraints? Have a workshop, thrash it out, and then you find that people um . if I say a load of different functions they'll all think of constraints, but when you actually get it all out in the open one of them might be a minor one' (Andy Pepper, Interview, 25/10/2000)

This approach is less participatory than that espoused by Maureen Fordham, implying that the decision makers undertake a first appraisal of the site before a workshop is undertaken However, having a workshop at an early stage would enable ideas and constraints to be identified at the outset Clearly, the two different modes of appraisal have their benefits and their applicability will depend upon the site in question On the one hand, an entirely grassroots approach may not be wholly desirable as a knowledge of the practical and physical constraints to a project are required Yet, on the other hand, early public consultation is required to satisfy the public's concerns and requirements The mode of appraisal selected will also relate to the scale of project It must be said, however, that these ideas proposed by Maureen Fordham and Andy Pepper were not utilised on the QMRG The reason for this is that Andy Pepper became involved in the project at a very late stage, and the ideas he proposed related to what he would have done had he been involved from the start However, Maureen Fordham (Interview, 31/01/2001) felt that her approach was not adopted as the organisers were trying to 'engineer-out public debate because most people who were involved in it had a clear understanding of how awful public meetings are, and how threatening they can be ' Additionally, as a consultant within a hierarchical decision-making structure she found it hard to promote the approach to public appraisal which she wished to undertake as there was a desire amongst the NRA decision makers for questionnaire surveys and interviews, which could have also been related to current thinking at that time (September 1994) as participatory approaches were less commonplace than at present

(iv) Discussion

Placing high levels of trust in expert scientific information can be an outcome of hierarchical (and hence 'top-down') decision-making structures Hierarchical structures are characteristically undemocratic as they favour one group or one decision maker's view over alternative knowledge bases Placing trust in the expertise of one individual or an individual knowledge base can be risky Had public appraisal on the QMRG adopted a more bottom-up approach then the risk of flooding could have been identified earlier and much money and time saved Conversely, however, when time and money are limited, hierarchies can be beneficial as they ensure that components of a project are executed within the bounds of those constraints Thus, hierarchies enable decisions to be made rapidly (rather than legitimated democratically) facilitating implementation at a faster rate than would otherwise be possible This is important when grants available for appraisal have to be spent within short periods of time

Although this discussion has been critical of the use of hierarchies in decision-making structures, it is important to be aware that the decision-making structure used on QMRG, and the decision makers involved in the project, were not decided at the outset (unlike the following two case studies) This structure (Figure 25a) and the project's appraisal framework emerged in the form that it did because the project was initially hypothetical, hence public appraisal focused on public acceptance of restoration *per se* and not on their input into project design Also, at the time, restoration was conceptually new, hence those NRA representatives located at the top of the decision-making hierarchy found it extremely hard to gain internal support from higher level decision makers within the NRA This internal power hierarchy may have preconditioned this NRA-led, highly scientised approach to decision making, as NRA project managers had to promote this project internally using scientific fact rather than public preferences as a more powerful bargaining tool to get the project started These internal negotiations also determined that the appraisal process would be punctuated by phases of activity and inactivity, as funding was not secure from the outset and once gained had to be spent within one financial year This forced decision making and appraisal to be undertaken rapidly, hence negating truly inclusive public involvement in the project. This unclear appraisal structure meant that decision making did not follow a logical trajectory and, as a result, the project did not proceed along a sequential path from project development through to construction

From this discussion it can be seen that hierarchical decision-making structures are not necessarily a conservative use of time and money They can encourage important decisions to be made in haste It is interesting to note that, as the key representative of the environment and promoter of sustainability, it was the NRA's internal structure and the manner in which it allocates its funding which caused decision making and appraisal on the QMRG to lack democracy, impeding its potential sustainability However, it is also important to appreciate that the localised decision making employed at Queen's Mead was a product of the wider regional and national context in which no single fund exists for restoration projects, forcing reliance on funding from other functions within the NRA and also from external sources The QMRG also commenced at a time when the notion of sustainability was beginning to gain greater political salience and hence more bottom-up approaches to decision making were still relatively novel Thus, although hierarchies do not necessarily confer sustainability, they can facilitate the undertaking of appraisals which are legitimised through science

7.3.2 Bilateral decision-making structures and structured appraisals

On the CRRP project the project's appraisal and trajectory was guided by a bilateral decision-making structure. This project's European ties strongly influenced the direction the project took and the nature of decision making, as it required the project to showcase the reversibility of environmental degradations without allowance for physical failure The CRRP management structure was composed of a range of different stakeholders representing statutory bodies, NGOs, consultancies, landowners and members of the public The RRP management structure on the other hand was quite unique in that it was composed of and led by UK aquatic conservation experts within the field of restoration These experts primarily emanated from consultancies, statutory bodies and academic institutions Most of the day-to-day decision-making on the Cole was undertaken by the CRRP management group, though it was also guided by the RRP's underlying management structure and the organisation's aims and objectives Decisions made by the CRRP management group and individuals within this group were guided by the RRP and EU Life's broader goals and mission statements, with ultimate influence on the project's appraisal and trajectory

The bilateral nature of the decision-making structure facilitated effective decision making as it ensured that decisions were appraised and hence legitimised by two groups, though this process of legitimisation was expert led The two staged decision-making structure facilitated a structured and logical process of appraisal which ensured that all phases of the appraisal were thoroughly undertaken Having said this, stakeholder mobilisation and appraisal was not as inclusive and extensive as would be desired and decision making within the CRRP management group was not entirely inclusive

(i) Influence of institutional goals on project trajectory

Nested within the aims of EU Life, the CRRP had to demonstrate state-of-the-art restoration techniques undertaken within a holistic catchment-based framework with a strong requirement for appraisal (referred to as monitoring) These broad European aims honed the project's appraisal, requiring that the site be rural, hence influencing the site selection process The CRRP's vision plan also

> 'translated the diversity of actors – natural, social, political, technological – into the centre, bringing their knowledges and capabilities within the RRP's ideas and practices, as the RRP successfully wrapped the translation around its own interests' (Eden *et al*, 2000 267)

Additionally, 'the local restoration was simultaneously part of a European restoration process' (Eden *et al*, 2000 267), as EU Life required the project to demonstrate the use of a range of restoration techniques to reverse degradation. This meant that the project's appraisal and design was encouraged to incorporate new techniques and materials (e g geotextiles) so that future restoration projects could transfer the usage of such techniques onto other sites These requirements, in combination with the EU Life's finite budget, parameterised the project's scope and, by specification of these key requirements, had an indirect influence on project appraisal and decision making EU Life's specification of the need for a catchment basis symbolised this project's location in the context of wider global debates surrounding sustainability which had recently been addressed in 1992 at UNCED However, whilst adhering to the rhetoric of sustainability, EU Life still emphasised that restoration be achieved through application of highly scientised 'techniques' rather than through the restoration of physical 'processes' Thus, although the underlying concept of sustainability was accepted, its more social (i e public participation) and holistic application were not fully implemented

The dual goals of RRP and EU Life thus influenced decision making and hence the appraisal process as designs had to incorporate both of their sets of goals. This reduced the legitimacy of the decision-making process for the public as it set specific parameters which had to be included in the project's design, necessitating the use of science as the dominant discourse This need for science was also dictated by the RRP's future role in which it would be required to compile a manual of scientific techniques to be used by practitioners This thus reduced the opportunity for the incorporation of alternative knowledge bases

(ii) The role of experts

The formation of the RRP and the CRRP management groups was framed within the context of EU Life's aims and objectives which fed through into the RRP's mission statement which made clear its dedication to the restoration of river-floodplain interactions and information dissemination. The achievement of these aims was also reflected in the individuals who were selected to join the RRP management group with a preference for technical (and hence scientific) expertise For example, the eco-geomorphological post-project appraisal may not have been undertaken had Jeremy Biggs and David Sear (both scientists) not formed part of the team and gained further funding in order to undertake post-project appraisal To fit with the RRP and EU Life's prerequisite of floodplain restoration, the channel designs also had to fit the desired hydrological regime which would force water out of channel onto the floodplain, and hence were not driven by geomorphological templates At the time of the CRRP's inception, the science and practice of restoration was still in its infancy Combined with the technical constitution of the RRP management structure this meant that the project's appraisal and design was influenced by current ways of thinking, embracing the concept of catchment management yet still focusing on the application of isolated restoration techniques

The manner in which decision making was undertaken in the CRRP management group was driven by the RRP management group and EU Life's ideologies and pre-requisites This meant that decision-making power was diluted by the time it reached the CRRP group Thus the structure of the project's appraisal and implementation was not negotiable as key parameters had been already established by more powerful decision makers Although scientific knowledge was given primacy on this project, it can also be seen that some types of scientific knowledge were prioritised over others during the project's design, reflecting the composition of the decision-making groups For example, the fact that channel designs were not geomorphologically driven related to the fact that David Sear's involvement in the project occurred more in the post-project stage

Chapter 6 also highlighted the tensions between different scientists during decision making, as Alastair Driver (an ecologist) and Andrew Brookes (a geomorphologist) had to negotiate a compromise during the design of the Cole's channel cross-section The following quote (part of which was used in Chapter 6) exemplifies the tensions between different disciplines during decision making It also indicates the tight time constraints within which fundamental decisions about project design were made

> 'I remember having healthy discussion with my colleague Andrew Brookes who was the geomorphologist who influenced the scheme I remember sitting down with him We had to design the upstream section where it cuts through the field We designed it at the drop of a hat We had a tight deadline, and we literally sat down and sketched it out I remember having this debate with him about how small the channel should be Basically, Andrew Brookes was very keen to use geomorphological principles, using standard equations of relationships between flow, cross sections and the rest I was basing my judgement on gut feeling and field experience, knowing how the channels behave in this catchment I wanted the channel to be smaller and shallower, I wanted them to be smaller in cross-section. In the end we compromised' (Alastair Driver, Interview, 21/2/2001)

This example points to the fact that even when making fundamental decisions which stand to affect a project's effectiveness, decision making is often made in haste (in this case during a sketch in the field) and thus science becomes replaced by individual decision makers' subjective preferences and 'professional judgement' based upon technical/scientific experience This highlights the fact that science is not necessarily beyond debate, and fundamentally different opinions between scientists from different disciplines can emerge

The CRRP management group also had an internal decision-making hierarchy composed of a working group whose suggestions had to be appraised and agreed upon by a project board (composed of statutory bodies) It was indicated that whilst this approach was useful in drawing together the visions of a large number of people it was, however, difficult to resolve the different requirements of decision makers from different scientific backgrounds Once again, the presence of different ideas for the site based on a mixture of science, experience and preference is evident, as is the informal nature of the compromises reached between them.

This internalised decision-making structure further restricted the project's appraisal and had to include the EA and the National Trust's requirements alongside the EU and RRP's corporate aims. Despite the limits imposed by this multi-layered, expert-led decision-making structure it also benefited the project's appraisal and trajectory. As seen in Figure 25b, project appraisal and trajectory were clearly and logically structured Through a phase of visioning the experts on the management group drew up options for the site which were based on their field of expertise (and hence particular disciplinary bias) Final options for the site sought to appraise and democratically combine as many of these options as possible Although the final design outcome was reached through a process of compromise, clearly individual components of the vision would be a product of individuals' conceptions of what constitutes a 'natural' vision for the Cole, and also the RRP's wider aims and objectives

The multidisciplinary nature of the team also imposed constraints as different disciplines did not always agree, and on the occasions that they did agree they did not necessarily prioritise components in the same order (Martin Janes, Interview, 08/05/2001) For example, had there been greater geomorphological input during the design stage of the project appraisal then design options may have differed substantially. Fisheries wished to install more gravel within the reach, but from a geomorphological and flood defence perspective this was not desirable as it would raise bed levels further and may increase flood risk so this element was not incorporated in the project Additionally, the following quotes from Alastair Driver and Nigel Holmes (both from ecological backgrounds) highlight the tensions between the ecological and engineering "factions" during project design

> 'I also wouldn't have bothered with the construction of the weir at the tail end I never thought that weir was necessary. The engineering faction suggested that it stay in, playing safe, they didn't want to risk erosion, but we now know that its completely buried' (Alastair Driver, Interview, 21/2/2001)

> 'You can always look back and think you could do things different Technically I would have preferred to take a less engineered approach to the re-meander' (Nigel Holmes, Interview, 24/04/2001)

This emphasises the strong influence that the disciplinary backgrounds of decision makers can have on project appraisal, trajectory and design It also reflects the fact that the range of different disciplines involved in decision making on this project was vast, hence the project's appraisal had to strike a balance in the range of knowledge through a process of compromise in order to incorporate the requirements of the different disciplines So, although recruitment of an expert decision-making panel can benefit a project's design, ensuring a broad and holistic scope, it is crucial that this panel is selected with as wide a disciplinary input as possible Having said this, on the CRRP disciplinary biases were lessened by appraising all decisions prior to implementation across two levels (the CRRP and RRP management groups)

Despite the existence of such a strong and expert decision-making structure on the Cole, one of the most acclaimed features of this project has been the meander bend adjacent to a line of old willows which was incorporated into the project at a later stage The success of this feature leads us to ask why it was not incorporated into the design earlier, and ultimately to question the efficacy of such a complex decision-making structure This also emphasises the fact that no matter how well structured the decision-making process, and no matter how scientifically informed the individual decision makers, in the end project appraisals involve making educated compromises between different possibilities and preferences which are often biased towards individual values or disciplines Balancing these compromises is made all the more complicated on large multidisciplinary teams, necessitating clear-headed and un-biased project management without which decision making and appraisal is rendered ineffective with components of projects not sufficiently legitimised The complexity of environmental decision making in multi-disciplinary teams is further exemplified by David Sear When asked his opinion on Alastair Driver and Andrew Brookes' channel cross-section designs he commented that

> 'The planform itself was designed on the back of an envelope based a little bit on the old channel marked on historic maps The downstream site was sort of an ecological-special The first I saw of the design was a sketch which had lots of bends and curves and backwaters So in that sense no geomorphological rationale behind it at all, which is fascinating There was a bifurcation between the geomorphological input and the way the project was drawn' (David Sear, Interview, 15/03/2001)

This statement indicates the fact that differences in opinion are not limited solely to different disciplines but even within the same disciplines different people may have different perceptions and have to respond to different pressures and timescales Personal preferences and perception render decision making an extremely complex process and in this case the final design was a compromise between the requirements of decision makers who practised very different forms of science, one empirical and one theoretical

(iii) Stakeholder mobilisation

The CRRP was undertaken on privately owned National Trust farmland, and although the farming tenants were appraised and represented by the National Trust on the CRRP management group their more direct input into the project design process was limited Here a fourth tier of decision-making power is evident, whereby the National Trust as the landowner imposed river restoration on its less powerful tenants By representing the voices of these tenants at working group meetings, the National Trust used these voices as a bargaining tool to direct the appraisal process This bargaining approach gave the National Trust the power of veto, and also enabled them to bind RRP legally to an agreement to reverse the restoration project should it fail On the one hand, the National Trust used their farmers to shape the project's trajectory, and, on the other hand, they imposed RRP and EU Life's vision of floodplain restoration onto the tenant framers This resulted in the farming tenants feeling that once the National Trust had agreed to the scheme there was minimal opportunity for discussion, and that their local knowledge about flooding was not accepted by the restoration managers (Tunstall *et al*, 2000b 369) Here the National Trust demonstrated its ability to reconfigure the power relations present on the CRRP project and alter the project's appraisal and trajectory to fit with their own goals, reflecting a national move within the National Trust towards the undertaking of more river and floodplain-based projects Despite its decision-making strength, the National Trust's power was reduced to a certain extent by its reliance upon the scientific expertise of both management groups The role of the National Trust in the decision making process was highlighted by Richard Morris (National Trust Estate Manager) in the following statement

> 'So I suppose my role there was to really let the boffins and the experts have their free rein but to have that practicality of saying I don't think that will work well, or whatever, or how can you guarantee that we won't flood half the village?' (Richard Morris, Interview, 17/05/2001)

Although the National Trust had to place a certain amount of faith in the scientific expertise of the individual decision makers (referred to as 'boffins' and 'experts'), Richard Morris ensured that practical concerns of the local community and the farmers were addressed and hence incorporated into the appraisal process Therefore, although the scientific nature of the CRRP meetings could have the potential to alienate a lay audience the power of the National Trust as landowner ensured that practical concerns were addressed

In terms of the local public, parish meetings and public meetings acted as a platform for decision makers to inform these stakeholder groups The flow of information was one way as these events did not give much scope for the public to inform the decision-making process Thus, the scientific backgrounds of most decision makers affected the manner in which non-scientists were appraised, keeping the input of non-scientific knowledge at a minimum This approach kept local residents and farmers at arm's length, ensuring that decision making remained in the hands of the experts The CRRP's appraisal and trajectory was thus governed by scientific principles, parameters which enabled it to be pragmatically undertaken within the allocated time period and to achieve EU Life's goals However, it did also reduce the legitimacy of the public appraisal, as the public were not entirely convinced of the project's success

(iv) Discussion

It has been seen here that the CRRP's appraisal and construction occurred against a backdrop of increasing recognition of the importance of the debates surrounding environmental sustainability (e g catchment management, public participation and geomorphology) This influenced who was recruited onto the bilateral management teams since a holistic and multidisciplinary team was required It also influenced the project's design, necessitating a move away from purely channel-focused projects which had prevailed in the past towards floodplain restoration The relative novelty of these debates meant that the techniques employed were often simply softer versions of past hard-engineering techniques. Also, lack of inclusion of geomorphology at the pre-project design stage meant that the appraisal and final trajectory of the project was not undertaken as successfully as was possible This bilateral decision-making structure was perhaps a victim of its own complexity Although it enabled final designs for the project to be appraised across two levels of decision-making power it alienated non-scientific stakeholders from active and inclusive involvement in the project's appraisal Although scientific expertise was favoured during decision making it was seen that in compromise situations more subjective conceptions of what would be 'natural' for the site were employed This demonstrated that although science is an important tool in project appraisal it is not all pervasive, and scientists from the same disciplinary background may not necessarily agree on a 'vision' for a site Additionally, different versions of science (empirical and theoretical) may lead to disputes during a project's design and compromise decisions maybe have to be made in order to incorporate both versions of science within a project The more subjective side of the decision-making process could have benefited from input from non-scientific stakeholders whose visions of what is 'right' for the site are equally (or perhaps even more) valid than those of the expert due to their local knowledge of the site, and their future usage of the site

7.3.3 Partnership-based decision-making structures and phased appraisals

On the UKRP the project's appraisal and trajectory was guided by a partnership-based decision-making structure This approach saw TW as central to the decision-making process since the project was both initiated and funded by them In this central position TW had ultimate power to accept or reject specific components of the project Despite this centralised position of power, TW made a conscious decision to step back from the actual process of project appraisal and design, redistributing power into the hands of two independent environmental consultants. Also, the Axford inquiry had portrayed TW in a bad light, thus engaging independent consultants as decision makers was a pragmatic move to facilitate the co-operation of the landowners in the project's design and appraisal Consultants were also employed for the practical reason that TW did not have the necessary expertise and needed the input of river restoration professionals A partnership approach to decision making was imperative on this project to help heal the tensions which emerged from the Axford inquiry Broadly, this local case study can be viewed within a wider context whereby local public and stakeholder groups are increasingly beginning to question the manner in which their local environment is managed and to demand a stake in decision-making power

This partnership approach necessitated the structured and phased approach to appraisal seen in Figure 25c. This involved the use of a demonstration project to secure stakeholder support, and later to demonstrate the benefits of the project through post-project appraisal Also, because multiple landowners were involved in this project, undertaking the entire project in one phase was not possible as negotiations with certain landowners were still being undertaken as the earliest projects were being constructed The ephemeral nature of the chalk stream also meant that a phased approach was necessary Thus, in order to facilitate both effective and legitimate decision making, the appraisal was structured in phases as this ensured that the project would be implemented in the given time frame This also gave decision makers the opportunity to fully engage individual landowners in the appraisal process.

(i) The influence of institutional goals

On the UKRP, the project's aims and objectives clearly influenced the nature of decision-making, its appraisal and trajectory. For example, one key objective was to reverse past environmental degradations caused by changes in land use and to use cost-effective techniques The first objective clearly influenced which sites were prioritised for restoration during the site selection process, as only sites which were wholly degraded were selected

'At the beginning we walked the river, we talked to landowners, we talked to the likely partners about the sorts of things we'd like to do The first thing to find out was the degree of degradation, what were the opportunities for rehabilitation and what were the views of the landowners We then came up with a series of options' (Nigel Holmes, Interview, 24/04/2001)

The second objective resulted in the decision to use softer restoration techniques which would have longer life expectancies and be self-sustaining For example, the *Ranunculus* spp snow shoes were created to help redirect the river's flow, and would be cheaper and more environmentally sustainable than hard engineering techniques TW's objectives reflected a change in scientific thought in the restoration community, whereby scientists and practitioners are beginning to suggest that restoration sites be selected strategically to preserve the best sites and to restore the most degraded sites It also signifies a move away from techniques-based projects such as the River Cole towards a more holistic form of restoration which seeks to restore a river's lost processes Hence, on the UKRP, current scientific thinking clearly influenced the project's appraisal as it ensured that designs effectively embraced current river restoration practice

(ii) The role of experts

The two consultants had central roles in the UKRP Although they were responsible for ensuring that designs and ideas were appraised by all stakeholders throughout the project, they often made decisions which limited stakeholders' – steering group, working group and landowners' – choices For example, in relation to the selection of rehabilitation sites, they independently classified the river into three types of degradation, then selected thirteen possible sites for rehabilitation along this 10km reach These sites were then presented to the stakeholders who had to select four sites for rehabilitation During this site selection phase, selection was also pragmatically gauged by whether landowners were likely to be receptive to restoration on their reach and whether the need for consent requirements would hinder the project's progress, thus further limiting the number of candidate sites Here, the two consultants' expertise in selecting appropriate sites was relied upon Although the stakeholders were given the power of choosing the four sites for rehabilitation, they had no influence in the selection of the thirteen candidate sites Here we can see a layering of power ratios between the experts, with the expertise of the consultants overriding those of the stakeholder groups When Nigel Holmes was questioned about how the visions for the sites were derived he stated that 'it was based on my knowledge of what sort of restoration work we'd carried out on chalk rivers previously, what might not have been done before but what might be effective' (Nigel Holmes, Interview, 24/04/2001)

Therefore, the designs for the site were influenced by Nigel's disciplinary background and his experience on previous projects According to Kevin Patrick, in this instance the landowners welcomed the arrival of their expertise

'Most of them [the landowners] have got enough money to do the work, but what they value most I think is the expertise. Suddenly it landed on their doorstep for free, you know without having to hunt down an expert They don't have to hire a consultant and they know they are getting good advice for free' (Kevin Patrick, Interview, 12/12/2000)

One concern with this approach is that had different consultants been selected then different sites and different projects may have ended up being selected and the appraisal process and project trajectory would have looked very different by virtue of personal difference and different disciplinary backgrounds However, when projects are constrained financially and temporally power ultimately becomes devolved into the hands of key decision makers (experts) to ensure on-time implementation The power of the experts can also be seen in the phase 3 site selection, whereby Hoppers Lane was identified as the least risky, yet Durnsford Mill was favoured as it provided better value for money This example demonstrates the fact that decision making is often more strongly influenced by practical matters such as finance as opposed to what would ideally be best for the site This project was thus not a true partnership in the sense that decisions concerning project appraisal and design were not equitably spread between all stakeholders However, steering group and working group members representing stakeholder groups were involved in the appraisal of the consultants' designs and were free to comment on and suggest changes to their content

Partnership clearly does not automatically confer democracy in decision making However, it does facilitate effective and on-time project implementation which are key when time and money are constraints This puts into question the legitimacy of the decision-making process on the UKRP both with regards to the science behind the decisions made and the inclusiveness of the decision-making process Science was used to appraise stakeholder opinion, yet the stakeholders were not allowed to appraise the effectiveness of the scientific opinion Having said this, an interesting point arose from the interview with Kevin Patrick Whereas Nigel and Kevin were trying to promote projects which reconnected rivers with their floodplains, the landowners did not wish floodplain projects to be undertaken on their land The reason behind this was that during the period of over-abstraction water levels in the river had become lowered The landowners thus felt that projects which restored floodplain connectivity would rob water from these watercourses, they therefore requested that the water remained in-channel Furthermore, during the early phases of the project extreme weather conditions caused severe flooding on both the river Kennet and throughout the UK At that particular time there was much local and national media exposure regarding flood risk and the effects of climatic change on water levels The landowners were affected by this turn of events and suggested that maybe a flood alleviation scheme may now be more appropriate than a restoration scheme. These two examples highlight the influence of the media upon stakeholder opinion, and whilst local knowledge is needed in such projects, ultimately such projects need to be managed by an impartial project manager otherwise a project in order to ensure that the final project created does not exacerbate stakeholders' concerns

(iii) Stakeholder mobilisation

In the case of the UKRP, Nigel Holmes' reputation and expertise in the field of river restoration was trusted by TW and the other stakeholders, and taken to be a reliable and expert conception of what would look and function naturally In this position of power, Nigel's judgement strongly influenced the project's appraisal and trajectory However, the knowledge of additional stakeholders on this river – including anglers, river keepers and the local knowledge of people who had spent years observing the river – was also deemed an invaluable source of information to the consultants during project design and implementation (Nigel Holmes, Interview, 24/04/2001) Nigel emphasised in particular the important role the local river keeper had in influencing the project's designs·

> 'We were very lucky in that one of the guys along the reach manages the Crown Estate for quite a large section of the river So he knows the river incredibly well He's also done a fantastic amount of river rehabilitation on his own back. So we had the advantage of talking to him One of the key things you need to make sure is that when you do something to the river system you know how that river system is going to respond. Its very dangerous to say "oh yeh, we'll have one of them, one of them and one of them because they look nice" Because you need to know, you need to try to observe the river, or talk to people with the right sort of knowledge . people who know how that river is going to respond when you do what you think is going to be a good idea, otherwise when you do it, what you thought would be a good idea could turn out to be a bad idea' (Nigel Holmes, Interview, 24/04/2001)

Nigel Holmes acted as a central axis in the partnership relationship established with the landowners, as he generating a much needed sense of trust This enabled them to comment on options, put forward their ideas and to aid site selection prior to all-group meetings His dialogue with non-scientific stakeholders, as seen above, enabled him to incorporate non-scientific knowledge into the decision-making process, whereby he could trial his and Kevin Patrick's ideas in front of someone who knew immediately how this river functioned This reiterates the importance of the role of local knowledge in decision making

In this case study it is also important to question whether decision making would have been as inclusive had a different person had Nigel's role Relying solely on the expertise of a few select individuals is a risky means of legitimising a project, as, scientifically, the project's effective and hence sustainable implementation will depend fundamentally on whether the individual's science is the right science for the project For example, solely relying on the expertise of an ecologist may reduce a project's effectiveness due to a lack of geomorphological or hydrological input Additionally, relying on one individual may also compromise a project's inclusiveness, as the extent of inclusiveness will depend on the individual's interpersonal and public relation skills and their ability to communicate scientific information sufficiently to stakeholder groups, and also their ability to feed stakeholder opinion back into the project's appraisal and design

(iv) Discussion

Prior to initiating the rehabilitation measures on this project a demonstration project was established to show landowners and the local community the benefits of rehabilitation and the nature of the work planned This first phase of the project was found to be a good means of gaining the support of landowners and, to a lesser degree, the local community Although TW needed to be seen in the local community to be addressing their environmental concerns, the rehabilitation projects would not be visible to all people – except from public footbridges and during public open days when local people can visit the projects – due to the private nature of land ownership on the Kennet Precursory demonstration projects are beneficial as they help gain support and enthusiasm for projects. They also reduce feelings of fear and scepticism which may be felt locally Having said this, they can be risky as they can pre-empt local perceptions and desires for sites In addition, they can also precondition people into accepting or desiring a future vision for their reach which may have been different had their views been appraised independently This approach can thus force current scientific discourses onto lay communities influencing their knowledge bases and decision making.

As the most current of the three projects, the nature of the project's appraisal can be seen to fit with recent debates over sustainability whereby more bottom-up partnership approaches to decision making are gaining prevalence, as opposed to the top-down approaches employed in the early 1990s In a similar vein, more contemporary approaches to restoration have begun to move away from techniques-based approaches, seeing a greater reorientation towards previously lost physical processes within streams These changes in ideology influenced the manner in which this project was appraised and designed

7.4 Conclusion

This chapter has shown that a project's appraisal structure and the composition of its decision-making structure both influence the project's final design and implementation, with the appraisal structures utilised having a strong influence on how effectively decisions are made, implemented and legitimised

The structure and composition of the decision-making process also affects which components are appraised and how this appraisal is undertaken This, in turn, influences both how effectively decisions are implemented, and how inclusive and legitimate the decision-making process is. Similarly the structure and composition of the appraisal framework affects what, how and by whom decisions are made

The last three chapters have documented three very different decision making structures and appraisal structures. The differences between these projects emerged for a range of reasons The three projects possessed very different backgrounds physically This affected the nature of the projects undertaken as each project possessed different environmental constraints and requirements The case studies also possessed different backgrounds socially, in that they had different stakeholder groups whose requirements were specific to the site in question In addition, the three projects were selected and undertaken for very different reasons This, combined with the different requirements and time-scales of each project's funding sources, influenced the nature of the final project undertaken, and the decision-making and appraisal structures employed

Within each project the decision-making structures were composed of a wide range of different decision makers who came from a variety of different institutional and disciplinary backgrounds. These ranges of backgrounds affected what and how decisions were made and the nature of the project appraisal undertaken In all three case studies certain individuals had stronger voices than others, either by virtue of their personal characters or their role within the project in question Undoubtedly, an individual's ability to convey their ideas for a project and convince others of its importance in a project has a strong bearing on the appraisal process, influencing the components of a project's final design All three projects would undoubtedly have emerged differently had a different range of individuals been involved in project appraisal and decision making

Through the case studies it was also seen that different branches of science (e g ecology, geomorphology and engineering) do not necessarily always agree with one another In such instances disputes were resolved through the development of compromise solutions which incorporated the concepts and requirements of both branches of science Ultimately, the ability of decision makers to resolve disputes is essential in reaching compromises, however, had one decision maker perhaps been less vocal then different solutions may have been derived and different designs would have emerged This example points to the fact that a project's appraisal and final design will always be to a certain extent unpredictable Therefore, whilst an appraisal framework as specified in Chapter 2 can help to design a project it cannot predict the decisions or requirements of the different decision makers or stakeholder groups As a result, it is difficult to propose fool-proof measures which will enable projects to be implemented both entirely effectively and legitimately

The following chapter concludes this thesis drawing together the results of Chapters 4 to 7, evaluating the efficacy of the appraisal framework proposed in Chapter 2 and proposing both a theoretical critique of this framework and practical guidance for the future of river restoration project appraisal in the UK

Chapter 8. Conclusion

8.1 Introduction

The primary aim of this thesis was to critically evaluate the incorporation of appraisal techniques and frameworks into river restoration projects in the UK as a basis for informing future policy and practice This evaluation of the appraisal of river restoration was undertaken at two different spatial scales – nationally and regionally

The national investigation (Chapter 4) was designed to be extensive and involved the establishment of the nature and range of UK restoration projects and their associated appraisal procedures undertaken to date. The forms of appraisal used in these restoration projects were evaluated against the appraisal techniques and frameworks recommended in the practical restoration and policy literature In Chapter 2 an ideal-ype appraisal framework was developed from the literature as a tool against which to evaluate the nature and extent of river restoration project appraisal in the UK Public participation, geomorphological appraisal and catchment-based appraisal were established as key to project success and were focused on throughout the thesis

The regional investigation (Chapters 5 to 7) adopted a case study approach, involving the detailed examination of how appraisal has been incorporated into river restoration projects, and identifying the barriers to undertaking project appraisals The two objectives of this investigation were to evaluate

- The practical application of different appraisal frameworks and their associated decision-making structures through comparison of the appraisal frameworks utilised against the ideal-type model put forward in Chapter 2, and
- The extent to which river restoration projects were undertaken within a structured framework of appraisal and incorporated techniques and frameworks proposed in the literature discussed in Chapter 2

This regional investigation led to an understanding of

- Stages and components of the appraisal frameworks;
- Constraints and benefits of the different appraisal techniques utilised,
- Involvement of stakeholder groups in decision-making processes,
- Structure of those decision-making processes, and
- Techniques used to appraise public perceptions

The two phases of investigation aimed to identify the barriers to incorporating effective appraisal frameworks and appraisal techniques into river restoration projects The purpose of this was to highlight potential solutions, changes and recommendations to the science and practice of restoration, which would in turn encourage a more effective incorporation of appraisal into restoration projects These recommendations could then be utilised to propose changes to the appraisal frameworks reported in the literature and to help to guide future restoration projects

This chapter draws together the key empirical, theoretical and practical findings from the national and regional investigations Section 8 2 is both empirical and theoretical and commences by discussing the critical results of this research. These results are then used to evaluate how effectively UK river restoration projects incorporate the appraisal frameworks and techniques proposed in the literature. Barriers to project appraisal are identified and ways forward to circumvent these obstacles are proposed Section 8 3 is more practical, as it revisits and critiques the appraisal framework proposed in Chapter 2 in conjunction with the results of Chapters 5 to 7 This framework is further evaluated in the light of a workshop on river restoration appraisal undertaken in November 2002 Section 8 4 concludes this thesis discussing the future of project appraisal and changes required to the manner in which river restoration and river management are undertaken in the UK

8.2 Critical research findings

8.2.1 Results of the National Investigation of river restoration appraisal techniques

The key findings of the national investigation were

- 81% of UK river restoration projects had been appraised,
- Thames region of the EA was seen to have undertaken the most project appraisals,
- In Thames region of the EA it was seen that funding is set aside annually from the flood defence budget to undertake restoration work,
- Photography, fisheries surveys and site visits were seen to be the most commonly used appraisal techniques,
- Fast and cheap appraisal techniques were favoured over more in-depth and time consuming alternatives, and
- The project appraisals undertaken across the UK were however, seen to have been undertaken at one or two stages of a project but not throughout its duration

This investigation showed that project appraisals were undertaken nationally, the number of projects appraised differed regionally, with the Thames region leading the way This trend was shown to be related to the fact that Thames Region of the EA has funding set-aside for restoration projects It was also seen that different regions face different environmental pressures, therefore the number of restoration projects undertaken and hence projects appraised can be related to the extent of degradation within individual regions

The main constraints to undertaking project appraisals nationally were seen to be

- Lack of time and money,
- Confusion amongst practitioners as to what appraisal really involves,
- The manner in which project funding is allocated, which prevents project appraisals by forcing projects to be executed within a single financial year, and because
- No one specific organisation is responsible for funding or undertaking river restoration projects or project appraisals

These constraints prevent projects from being undertaken in a truly holistic manner within a framework of project appraisal such as the one depicted in Chapter 2

Despite the range of factors which were seen to constrain both river restoration and project appraisal, it was seen that in the UK there exists a wide range of organisations engaged in the practice of river restoration These organisations were seen to have developed a broad range of river restoration and appraisal techniques to contend with a diverse range of environmental pressures enabling projects to be undertaken and appraised within tight budgets

In the future there is a need for organisations to reconsider the manner in which funding is allocated on projects, setting aside sufficient funds for project appraisal Whilst budgets may have to be spent within tight time scales it is important to realise that restoration projects are long-term projects and it is not possible to appraise a project's a success the same year it is constructed There also exists a general need to develop guidance for practitioners to explain the basic requirements of project appraisals, such as how to develop measurable aims and objectives and the timing of appraisals

8.2.2 Results of the Regional Investigation of river restoration appraisal techniques

A key finding of the regional investigation was that appraisal structures and decision-making structures are interdependent – they shape each other This has implications for a project's design as practitioners need to consider not only the most appropriate appraisal structure but also the design of the decision-making structure

Through analysis of the case study sites it was shown that the decision-making structures adopted on each project differed greatly due to the variety of institutions and agencies involved, the variety of reasons for restoration and because no set formula exists for how decision making is to be undertaken on river restoration projects. As a result of these differences the three case studies unsurprisingly possessed very different decision-making structures. The structures utilised all enabled decisions to be made but in different ways and with different implications for each project's appraisal A key finding of this thesis is that whilst it is important to get the appraisal structure right it is also necessary to give consideration to the composition of the decision-making structure as this has a significant effect on the project's appraisal and trajectory

The regional investigation also involved analysis of the appraisal structures employed on the three case studies Chapter 6 showed that the appraisal structures utilised on the three projects differed substantially. These differences were seen to be related to the very different decision-making structures and the individual decision makers included within these structures These differences influenced the effectiveness of these appraisals, the manner in which each project was implemented and the extent of the public involvement within these projects

This key research finding has three main implications First, that different decision-making and appraisal structures give prominence to certain individuals on projects This was demonstrated in Chapters 5 to 7 of this thesis where it was seen that irrespective of how comprehensively appraisal processes are structured a project's trajectory can be strongly influenced through the composition of its decision-making structure For example, with certain sorts of decision-making structures individual decision makers who have strong characters or opinions may influence strongly the direction of a project's appraisal Indeed, individuals representing different branches of science may disagree on a project's trajectory and there need to be effective ways of resolving these disagreements These points indicate how influential individual decision makers can be on a project and emphasise the importance of giving consideration to both the structure and composition of the decision-making structure to ensure that a wide range of individuals and disciplines influence the project's appraisal On the UKRP the partnership-based decision-making structure placed importance on the use of trusted individuals as key decision makers Whilst this approach was beneficial in that it facilitated a smooth path of communication between stakeholders and decision makers it possessed disadvantages in that the project's trajectory was heavily influenced by key decision makers' aspirations and disciplinary background From this example it can be seen that different types of decision-making and appraisal structures give prominence to different types of individual ultimately influencing the project's trajectory Therefore, on new projects it is important for consideration to be given to not only the structure of the appraisal but also how decision making is structured and who is included in decision making If this is not considered then the legitimacy of decision making will be compromised and the trajectory of projects will be influenced by decision makers' visions rather than stakeholders' preferences

The second implication of this research finding is that the extent of public participation in individual projects is influenced greatly by the decision-making and appraisal structures utilised For example, On the QMRG, the use of a an *ad hoc* appraisal structure gave greater prominence to scientific knowledge leading to the appraisal of public opinion being undertaken at too late a stage in the project. This had clear implications for the project's trajectory as the public meeting undertaken at a late stage in the project confirmed that the proposal would be unacceptable in that it could potentially place properties at risk of flooding In order for the public to be given the optimum opportunity to influence a project it is therefore necessary for their opinion to be appraised at an early stage, because if undertaken too late then it may prevent a project from going ahead. When designing a project it is therefore important to strike a balance combining both 'expert' and 'lay' knowledge in the creation of outcomes which benefit the environment yet also incorporate the needs of the local community, the public therefore need to form part of both the appraisal and decision-making structure The presence of a trusted figure or public liaison officer engaged in the decision making process can be beneficial, as this can help ensure that all members of the public are included in a project, providing a link between the local community and the decision makers In all three case studies examined in this thesis the public were not central components of either the appraisal structures or the decision-making structures Indeed, had more extensive public inclusion in decision making and the project appraisal structures occurred then the trajectory of the appraisal processes may have differed

The third implication of this research finding is related to the relationship between scientific and lay knowledges, and the influence of this relationship on decision-making structures and appraisal structures Through the three case studies it was seen that different branches of science (e g ecology, geomorphology and engineering) do not necessarily always agree with one another Furthermore, in some instances even individuals with the same disciplinary backgrounds did not agree with each other In such instances disputes were resolved through the development of compromise solutions which incorporated the concepts and requirements of both branches of science It was seen that, ultimately, the ability of decision makers to resolve disputes is essential in reaching compromises However, had one decision maker perhaps been less vocal then different solutions may have been derived and different designs could have emerged These case studies also showed that scientific knowledge was more readily appraised than lay/stakeholder knowledge as decision-making structures were primarily composed of scientists This led to decisions being driven by scientific knowledge which had implications on what was appraised and the structure of the appraisal process utilised For example, on the CRRP the bilateral decision-making structure was composed of primarily scientific decision makers which led to the development of a structured appraisal process in which alternatives to scientific knowledge were not readily appraised Future research needs to consider how to gain an effective balance between scientific and lay involvement in environmental decision making Science is clearly important in decision-making and appraisal on river restoration projects However, lay expertise, which has its basis in practical day-to-day knowledge of local environmental issues, is an increasingly valuable tool in creating projects which are both environmentally and socially sustainable. Decision-making structures which incorporate a range of different knowledge bases will be invaluable on future projects as they will ensure that the appraisal process is sufficiently well structured to appraise a project's success both physically and socially.

The influence of decision-making structures on project appraisal is one of the key research findings of this thesis as it has been seen that these structures have as much impact on a project's trajectory as the appraisal structure utilised This finding is important, and there is a need for future research on designing decision-making structures which facilitate adequate project appraisal There is also a need to consider the development of decision-making structures which encompass a range of different individuals with different disciplinary backgrounds whilst also ensuring the inclusion of a range of participating institutions and members of the public in this structure. It will be important for such a structure to be flexible as individual characters will have different degrees of influence in any one decision-making structure

8.3 Practical research findings

This thesis has shown that the appraisal framework depicted in Chapter 2 can be useful as a project guide However, its unaltered usage on restoration projects would be unlikely to occur as the structure which a project's appraisal takes is influenced by the range of factors which may constrain aspects of the appraisal process On 27th November 2003 a workshop entitled 'Appraisal River Restoration's Missing Link' was convened at Nottingham University by Lydia Bruce-Burgess (formerly of Queen Mary, University of London, now Environment Agency, North East Thames Region) and Dr Kevin Skinner (Haycock Associates and University of Nottingham) with the support of the River Restoration Centre (for list of delegates and results of workshop see http//www therrc co uk) The aim of the workshop was to draw together a select group of individuals to discuss various aspects of project appraisal The delegates included academics in the field of river restoration, environmental consultants and members of the EA, English Nature and DEFRA The outcomes of this workshop will now be discussed in the light of the findings of this research, enabling the appraisal framework developed in Chapter 2 to be critiqued and looking forward to the future of appraisal The different sections of the appraisal framework set out in Chapter 2 were used as starting points for discussion during this workshop, commencing with the topic of pre-project appraisal and site selection and proceeding through to post-project appraisal This same structure will now be used to discuss the findings of this workshop

(i) Site selection

Although it was accepted by the delegates that strategic site selection is very important it was highlighted in this workshop that often this opportunity is not available as sites are already pre-selected. For example, a local planning authority may have identified the potential to restore a section of a river in a park and may have set aside funding to facilitate this restoration However, this project may not have been selected by the EA within a strategic catchment context A strategic approach cannot always be achieved as restoration is to a certain degree opportunistic. Since this workshop, however, the EA Thames Region has begun to develop a more strategic approach to restoration through the development of river restoration strategies for both North and South London The North London strategy aims to broadly identify areas of opportunity for restoration throughout the individual river catchments of North London This strategy will identify techniques across a range of scales from river-floodplain restoration through to minor enhancements which may be appropriate across the physically-constrained rivers of North London This document will then be provided to local authorities, members of the public and developers in order to promote river restoration throughout this region Documents such as this can be used to promote the potential for future river restoration projects and can help delineate sites were opportunities for restoration may exist at a catchment level whilst also depicting sites where river-floodplain restoration may not be possible but minor enhancement works may be feasible

(ii) Pre-project appraisal

In Chapter 2 it was seen that this phase of appraisal should be carefully linked to the aims and objectives of a project to ensure that the data collected later facilitates post-project appraisal However, in this workshop, it was indicated that river restoration projects often have unexpected outcomes and some practitioners hence argued that it may be more sensible to collect a wide range of pre-project data and accept a level of redundancy That way it can be ensured that all components can be later appraised An additional reason for this approach was that unforeseen outcomes are often more educational than expected ones This approach could, however, prove costly especially if one considers that a geomorphological catchment baseline survey can cost between £150 and £300 per person per day In this light one of the delegates suggested that maybe we should not be appraising all projects but only large or significant projects where we are going to learn something new Whilst this approach may mean that we do not learn about smaller enhancement projects it may enable spending to become more targeted and ensure that a few projects are appraised extensively Indeed, another approach would be to sample a range of different projects over a variety of scales including a range of different techniques. It was also suggested that future research is needed to help ascertain what are the minimum requirements for project appraisal, so that detailed appraisals can be focussed on more significant sites, and less detailed appraisals on less significant sites

(iii) Objectives and goal setting

As has been seen throughout this thesis there is a general need for a project's objectives to be clearly defined and appropriate to the project in question The delegates at this workshop generally agreed that objectives should be set at a range of scales from the reach, through to the channel, river corridor and flood plain One delegate believed that river managers need to start assessing what are major objectives on a reach by reach basis by identifying where improvements should be located in the catchment and for whose benefit these improvements are being made This point clearly has implications for how we manage rivers in the UK Perhaps with the arrival of the EU WFD and the requirement for RBMPs this will enable river management activities to become more targeted and catchment based

(iv) Project installation

A need for good communication between project designers and project installers (contractors) was highlighted as being of paramount importance to a project's success, as often a project's design can be incorrectly implemented through contractors who are unfamiliar with the installation of river restoration projects This is an important point which need to be conveyed to future river restoration projects Future guidance on conveying project details to contractors who are inexperienced in river restoration may also be beneficial

(v) Post-project appraisal

One of the main comments made about post-project appraisal was the fact that we do not presently know the timescales for geomorphological dynamics or how a river will adjust to a new restoration scheme As a result, we do not know how regularly we should be undertaking post-project appraisals This means that we could be missing the measurement of major events Whilst some systems respond really quickly to change (over 3 to 5 year periods) others take longer A river's temporal response to change therefore needs to be considered in a scheme's design, monitoring and appraisal. This lack of understanding emphasises a great need for selection and detailed research-based appraisals of river restoration schemes to be undertaken from which we can learn the time-scales for natural recovery which will help us plan more effectively the timing of project appraisals

It was also emphasised that post-project appraisals need not only to compare to a project's objectives, but also to evaluate project outcomes This is because some outcomes can be totally unexpected It was also emphasised that it is important for the results of completed post-project appraisals to be made known to the restoration community to assist in future projects There is therefore a need to disseminate these results both academically and practically through mechanisms such as the RRC's Newsletters, Annual Network Conference and Annual Workshops

(vi) Adaptive management

The delegates at this workshop believed that river restoration should not be the end point of river management. System resilience and adaptive management should be the main issues that we should be working towards It was believed that if we possess robust programmes of adaptive management then we could tolerate a lower degree of monitoring since you can adapt a project rapidly should it fail or problems emerge at a later date It was also suggested that river restoration should be informing the way we currently manage our rivers so that we preserve those watercourses which are not degraded therefore circumventing the need for restoration at a later date There is a general need for river restoration practitioners in the UK to stop seeing the completed project as an end point. However, the manner in which funding is allocated in the UK and the busy schedules of river managers is presently seen to prevent this from occurring

(vii) Appraisal framework

During this workshop the appraisal framework proposed in Chapter 2 was put forward as a potential framework of how appraisal could be undertaken Whilst some delegates agreed with the layout of this framework, others understood appraisal differently and saw appraisal as a component which is undertaken either at the start of a project or once a project is complete (post-project appraisal). The delegates who believed the latter saw the earlier stages of the proposed appraisal framework as different components of project design and did not recognise their linkage to the post-project appraisal stage Some delegates saw site selection as a process which needed to emerge from a strategic approach which commences at the supra-catchment level whereby national policies and requirements define a need for restoration which is then fed down to the catchment and finally the reach scale Whilst the concept of an all-encompassing appraisal framework was generally recognised as being useful it was also indicated that each restoration project has its individual drivers and constraints which may prevent the use of such a rigid framework (this also confirms the findings of the study element of this research)

(viii) Appraisal techniques

The workshop delegates also emphasised the fact that the appropriateness of different techniques should be considered on a scheme by scheme basis as there is a need to consider the form-process relationships when selecting techniques There is also a need for future research to be undertaken to examine the effectiveness of particular restoration techniques in a range of different environments This would then enable us to determine with more certainty the range of conditions in which these techniques can be successfully used In this workshop an additional need was identified for the development of a list of available project appraisal techniques For each appraisal technique the cost of undertaking the appraisal and the amount of time it takes to undertake would need to be specified This would enable practitioners to select appraisal techniques based on the amount of time and money they have available For example, on a low budget project where appraisal is not being considered due to financial constraints then the use of pre- and post-project fixed point photography could be considered as this form of appraisal would be better than not undertaking appraisal at all

(ix) Public consultation

Stakeholder dialogue was seen to be very important in this workshop, and it was emphasised that it should be continuous The importance of having technical experts available during public participation was highlighted as they can help explain a project's constraints and parameters According to one delegate the timing of public participation is crucial If it is undertaken too early it can lead to unfulfilled expectations, but if it is too late it can lead to tokenism. If the public are engaged in a project at an early stage they can be later used as a resource for monitoring and local groups can also be established to police the watercourses once the project is complete For example, in London the Lee River's Trust has recruited volunteer river wardens who are local members of the public who look after their local stretch of watercourse and promote a conservation ethic in the neighbourhood In Australia 'catchment care groups' are frequently established to engage communities in decision making and also in long-term monitoring of projects. Although initially time-consuming such approaches can have great long-term benefits as they can also reduce costs for statutory bodies, as engaging the public in decision making can also help gain their support (and their free labour) for undertaking project monitoring This also gives the chance for the public to learn from the expert, and *vice versa* Techniques such as the 'Riverside Explorer' (a CD-Rom version of RHS) have been espoused by Hawley *et al* (2002) as an educational tool used to teach school children about their local catchment Such approaches are very important as they can help educate people about the importance of catchment management, ensuring that successive generations are more environmentally aware

(x) Geomorphology

The importance of geomorphology in river restoration was emphasised in this workshop, with a range of geomorphological appraisal tools being discussed It was seen that whilst it is increasingly being incorporated into restoration project design and appraisal there is a future need for research to document different rivers' system-response time scales to river restoration projects in order to offer better guidance on the duration and timing of post-project appraisals This would enable us to ascertain how long it takes for river restoration projects to work and will also enable us to determine suitable time periods for undertaking project appraisals in order to ensure that the data we are collecting are meaningful and useful At present, geomorphology is seen to be the preserve of academic institutions and a few consultancy firms There is a future need for greater in-house training in the field of geomorphology for practitioners engaged in river restoration, especially in organisations such as the EA who are seen to undertake a great number of restoration projects throughout the UK This is presently prevented from occurring due to the structure of the EA and the make-up of its functional departments which do not include geomorphologists

(xi) The future of appraisal

A further item discussed in this workshop was the future of appraisal From this discussion it was indicated that there was a general need to adopt catchment-based approaches to river management, restoration and appraisal In relation to appraisal it was stated by one delegate that we need to collect information at a much broader scale as this can help to identify and address basic morphological problems that are occurring Linked to this, the importance of prioritising schemes at a catchment scale was emphasised, using catchment scale plans and policies which could be then fed down to the reach scale Through adopting a targeted approach to restoration we can also then target project appraisal. Whilst it has been shown that it is important to undertake project appraisals on all projects, the depth of the appraisal process required can be tailored to suit the scale of the project, the objectives of the project and the available finances

According to Everard (1998 478), catchment-based approaches to river management would not only help maximise habitat diversity and interconnectivity but would also minimise the management burden. Since the river would be potentially more environmentally self-sustaining it would also reduce future maintenance costs in relation to flood defence, as the floodplain would act as a natural flood storage reservoir This approach ensures that a project's design is based on a knowledge of sediment sources, sinks, transfer zones and areas of instability within a catchment According to Andrew Brookes (Cole working group meeting, 24/10/1994), river restoration needs to be imaginative to cope with modern problems This is an important point as river restoration schemes can also benefit from other initiatives that take place within the catchment Novel approaches to drainage and water management – such as Sustainable Urban Drainage Systems (recommended in PPG25 as a means of minimising flood risk, see ODPM, 2001) and washlands for flood defence (Morris, 2002) – have the potential to give added value to restoration schemes where they are employed strategically within the catchment By linking a range of different initiatives and schemes within a particular catchment it may be possible to achieve restoration, not just of the reach but of the catchment Everard and Powel (2002. 333) suggest that such activities have the potential to act as building-blocks which address local issues whilst simultaneously contributing to the capacity of catchment-scale ecosystem functioning

(xii) Summary of workshop

This river restoration workshop reiterated many of the points addressed in this thesis, especially the need for strategic site selection and the importance of developing clearly defined aims and objectives which are measurable throughout a project The importance of public and geomorphological appraisal was also emphasised Whilst the need for an appraisal framework was generally accepted it was also indicated that each restoration project is very different It is therefore important that any framework that is developed be sufficiently flexible This need for flexibility has been stressed throughout this thesis and is especially important if one considers that a project's trajectory is driven not only by its appraisal structure but also by the decision-making structure and by the individual decision makers involved in each project

It was seen in this workshop that practitioners believed project appraisal to be an important component of a river restoration project However, it was apparent that appraisal was seen purely as an isolated component to be addressed as part of a project rather than a process which shapes a project's trajectory throughout This research has shown appraisal to form part of a project from start through to completion helping to structure and guide a project's trajectory, whilst also offering tools – such as an RHS, a questionnaire survey or a fluvial audit – to assess a projects' success It is important that practitioners recognise that appraisal is not solely the end product of a project (a post-project appraisal), but has an important role to play from project inception through to completion and post-project appraisal

8.4 Conclusion

> 'In a world put at risk by the unintended consequences of scientific progress, social trust in scientific knowledge claims and institutions cannot be taken for granted Participatory procedures involving scientists, stakeholders, advocates, active citizens and users of knowledge are needed to transform knowledge claims into trustworthy, socially-robust, usable knowledge about the realities which matter in social and environmental change and in the transition to sustainability' (Kates *et al,* 2000 3)

This thesis has demonstrated the important role that appraisal has to play in the development of river restoration projects It has been indicated that although appraisal is presently undertaken in the UK, the depth and scope of these appraisals is often limited, with important consequences for the success of river restoration projects It has been shown that a change is needed in the way that rivers are managed in the UK in order to more readily incorporate project appraisal into river restoration projects

Section 8 3 demonstrated a practical need to develop a more strategic catchment-focused approach to selecting potential sites for river restoration More guidance is also required by practitioners on the types of appraisal techniques available, their cost and the time they take to execute This practical requirement could be created in a list type format and published on the RRC's web-site, this would assist individuals in the selection of appraisal techniques to fit within the budgetary and temporal constraints of their project Academically, the is a future need to further research and develop guidance on how best to design decision-making structures in order to ensure the equitable inclusion of scientific and lay stakeholders in the decision making process. This research need accords with the view of Kates *et al* (2000) that whilst science is vital to the development of sustainable environmental projects we can no longer afford to ignore alternative sources of knowledge which enable the linking of scientific and stakeholder knowledge in the development of management plans which will be both environmentally and socially sustainable Doing so means designing effective, inclusive and legitimate decision-making structures and appraisal processes that respond to the environmental and social demands of specific river restoration projects

Appendix A. River restoration appraisal covering letter

Dear ,

<u>UK river restoration projects an evaluation of appraisal procedures</u>

I am undertaking 'An evaluation of the appraisal procedures for river restoration projects in the UK' This research is jointly funded by the Environment Agency, Natural Environment Research Council (NERC) and the Economic and Social Research Council (ESRC), and is undertaken with the support of the River Restoration Centre (RRC) The overall aim of this research is to provide an evaluation of river restoration appraisal procedures in the UK as a basis for informing the development of future policy and practice This study does not replicate data already collected by the RRC It targets the appraisal procedure, a component of the river restoration process which has not been previously studied, and is not presently recorded in the RRC's database Once the data has been collected it will be added to the RRC's database

A component of this research involves a national survey of appraisal procedures to establish the nature of appraisal techniques undertaken to date in the UK The study aims to

- Examine all aspects of the appraisal process for river restoration projects,
- Establish the range of policies and practices,
- Record and analyse where and how successes have been achieved and where and why difficulties have been encountered,
- Incorporate results into a GIS package (Geographic Information System) for spatial analysis, and
- Document emerging ideas on good practice, leading to the production of guidance notes,

The principle outcome will be guidance notes on river restoration appraisal procedures based on the analysis of your collective experiences The analysis of this research will also form an important component of my PhD thesis, undertaken within the Department of Geography and Environmental Science Department, at Queen Mary and Westfield College, University of London Results of this research will be made widely available through the RRC website

I have produced a very short questionnaire specifically looking at the river restoration appraisal process I would be extremely grateful if you could spare a few minutes to complete the enclosed questionnaire I have included the information that I have already collected in order to speed up the process, so please fill in spaces where information is lacking Please could you also provide correct grid references as they are needed for compilation of the GIS database I apologise to those of you who have more than one questionnaire to complete

I would be much obliged if you could return the questionnaire by **14st of April 2000**, in the enclosed return envelope Your response to this questionnaire will enable a characterisation of appraisal processes at a national scale, which is of undeniable importance for the future of river restoration Thank you in advance for your co-operation, I appreciate that you are very busy If you would like to be kept informed of this study's progress please leave an e-mail address

Yours sincerely

Lydia Bruce-Burgess

Appendix B. Potential urban and rural case studies in Thames region

Project name	Rural	Urban	Appraised	Public perception work	Geomorphological appraisal	Total score
Bear brook realignment and flood alleviation scheme	✓	✗	✓	✗	✗	2
Dun habitat enhancement at Froxfield	✓	✗	✓	✗	✗	2
Windrush enhancement works	✓	✗	✓	✗	✗	2
Mole at Brockham (proposed)	✓	✗	✓	✗	✓	3
River Mole cut-off meander reinstatement	✓	✗	✓	✗	✗	2
Mole diversion, Gatwick airport	✓	✗	✓	✗	✓	3
River Chess enhancement scheme at Blackwell hall	✓	✗	✓	✗	✓	3
River Ver at Kingsbury Mill	✓	✗	✓	✗	✗	2
Tweed Rivers Heritage project	✓	✗	✓	✗	✗	2
Roding at Passford	✓	✗	✓	✗	✗	2
River Lambourne	✓	✗	✓	✗	✓	3
Ock	✓	✗	✓	✗	✗	2
Shabington	✓	✗	✓	✗	✗	2
River Waveney rehabilitation project	✓	✗	✓	✗	✓	3
Sutton estate- stage one	✓	✗	✓	✗	✓	3
Sutton estate- stage two	✓	✗	✓	✗	✓	3
Gatehampton	✓	✗	✓	✗	✗	2
Kennet and Avon canal- overflow channel	✓	✗	✓	✗	✗	2
Upper River Kennet, near Marlborough	✓	✗	✓	✓	✓	4
Cole- Coleshill	✓	✗	✓	✓	✓	4
River Lyde project	✓	✗	✓	✗	✓	3
Blackwater at Eversley cross	✓	✗	✓	✗	✗	2
River Dun	✓	✗	✓	✗	✗	2
River Thames at Wolvercote	✓	✗	✓	✗	✗	2
River Ock at Stanford Mill	✓	✗	✓	✗	✓	3
River Thames at Clifton Hampden	✓	✗	✓	✗	✗	2
River Thames at Pinkhill Meadow	✓	✗	✓	✗	✗	2
River Thames island conservation at Shiplake Lock	✓	✗	✓	✗	✗	2
Thames access road protection at Sonning	✓	✗	✓	✗	✗	2
River Coln at Quenington	✓	✗	✓	✗	✗	2

Roding at Abridge	✓	✗	✓	✗	✗	2
Ver-redbourne	✓	✗	✓	✗	✗	2
Pang-Hampstead Norreys	✓	✗	✓	✗	✗	2
Ock at Stanford Mill	✓	✗	✓	✗	✗	2
Mole cut off meander reinstatement	✗	✓	✓	✗	✗	2
Roding notch cut weir	✗	✓	✗	✗	✗	1
Sonning lock access road protection	✗	✓	✓	✗	✗	2
River Thames, Penton Hook wetland	✗	✓	✗	✗	✗	1
River Thames at Hampton Court	✗	✓	✗	✗	✓	2
River Ash- Spelthorne	✗	✓	✗	✓	✗	2
Gatwick stream- weir bypass, Grattons park ditch	✗	✓	✗	✗	✗	1
Blackwater valley road river diversion scheme (North)	✗	✓	✓	✗	✗	2
Blackwater valley road river diversion scheme	✗	✓	✓	✗	✗	2
Millennium terraces	✗	✓	✓	✗	✗	2
Wandle	✗	✓	✓	✗	✗	2
River Wye at High Wycombe	✗	✓	✓	✓	✓	4
Tidal river Crane enhancement	✗	✓	✓	✓	✗	3
Ravensbourne at Queensmead	✗	✓	✓	✓	✓	4
Ravensbourne (East branch) rehabilitation, Bromley Golf Course	✗	✓	✓	✓	✓	4
Kyd Brook deculverting at Sunbridge park golf course	✗	✓	✓	✓	✓	4
River Pool enhancements	✗	✓	✓	✓	✗	3
River Thames beach creation at London Yard	✗	✓	✓	✗	✗	2
Habitat enhancements on the Thame (Nether and Lower Winchendon)	✗	✓	✓	✗	✗	2
River Colne enhancement at Watford	✗	✓	✓	✗	✓	3
Skway trading estate	✗	✓	✓	✗	✓	3
Loddon and Blackwater	✗	✓	✓	✗	✗	2
Ford Brook	✗	✓	✓	✗	✗	2
Endbourn Road (Butlers)	✗	✓	✓	✗	✓	3
Thames, Rye farm meadow	✗	✓	✓	✗	✓	3
Crane park island	✗	✓	✓	✓	✓	4
Restoration of River Bulbourne	✗	✓	✓	✓	✓	4
River Brent enhancement project (in progress)	✗	✓	✓	✓	✓	4
River Wandle	✗	✓	✓	✗	✗	2
Deptford Creek- the Creekside programme	✗	✓	✓	✗	✗	2

Appendix C. Codes and sub-codes used in analysis of interviews

1 Background to project/site 1 1 Background 1 2 Who was involved 1 3 Definitions
2 Creation of an interdisciplinary team/workforce 2 1 Background 2 2 For each individual decision-maker, what was 2 3 Consultation in the interdisciplinary team
3 Decision-making process 3 1 Stages of decision-making 3 2 In relation to the individual decision-maker, what was. 3 3 Negotiations
4 Project design creation of a 'vision'
5 Appraisal process used to inform the design 5 1 Structure of the appraisal process 5 2 Timeframes 5 3 Other issues
6. Financing 6 1 Financial constraints 6 2 Funding available for monitoring
7 Constraints
8 Retrospective changes/ lessons learnt
9 The future of the project/ site
10 Wider issues

Appendix D. Regional summary of visual appraisal techniques (sum, %)

	Photos pre-project	Photos post-project	Aerial photos	Video
Anglian	20 (91)	15 (68)	/	/
Midlands	15 (83)	16 (89)	/	/
North East	8 (80)	6 (60)	/	/
North West	19 (100)	17 (89)	/	1 (5)
Southern	18 (82)	19 (86)	/	/
South West	17 (68)	17 (68)	1 (5)	/
Thames	63 (75)	59 (70)	2 (3)	/
Wales	13 (93)	13 (93)	/	1 (11)
Scotland	8 (67)	6 (50)	/	/
Northern Ireland	3 (43)	4 (57)	1 (20)	/
Sum	184 (79)	172 (74)	4 (21)	2 (1)

Appendix E. Regional summary of geomorphological appraisal techniques (sum, %)

	Channel cross-section measurement	Delineation of reference reach	Geomorphological modelling	Fluvial audit
Anglian	4 (18)	1 (5)	5 (23)	1 (5)
Midlands	6 (33)	2 (11)	5 (26)	2 (11)
North East	2 (20)	1 (10)	4 (40)	2 (20)
North West	8 (42)	3 (16)	9 (47)	5 (26)
Southern	7 (32)	/	7 (32)	5 (23)
South West	4 (16)	1 (4)	4 (16)	1 (4)
Thames	27 (32)	8 (10)	21 (25)	8 (10)
Wales	5 (36)	3 (21)	3 (21)	1 (7)
Scotland	3 (25)	/	2 (17)	2 (17)
Northern Ireland	1 (14)	/	2 (29)	/
Sum	67 (29)	19 (8)	62 (27)	27 (12)

Appendix F. Regional summary of 'other' appraisal techniques (sum, %)

	Cost Benefit Analysis	Environmental assessment	Landscape assessment	Return monitoring	Site visit	RRC audit	Academic research	Historical records
Anglian	4 (18)	5 (23)	4 (18)	4 (18)	12 (55)	/	/	/
Midlands	2 (11)	4 (22)	3 (17)	4 (22)	7 (39)	/	2 (11)	/
North East	1 (10)	1 (10)	2 (20)	3 (30)	2 (20)	/	/	/
North West	9 (47)	10 (53)	12 (63)	9 (47)	17 (89)	/	/	/
Southern	2 (9)	9 (41)	10 (45)	2 (9)	13 (59)	/	1 (6)	/
South West	6 (24)	8 (32)	10 (40)	4 (16)	9 (36)	/	1 (5)	/
Thames	14 (17)	26 (31)	22 (26)	9 (11)	36 (43)	19 (27)	3 (4)	2 (3)
Wales	1 (7)	3 (21)	2 (14)	4 (29)	6 (43)	/	/	/
Scotland	3 (25)	4 (33)	2 (25)	3 (25)	5 (42)	/	/	/
Northern Ireland	1 (14)	1 (14)	1 (14)	1 (14)	4 (57)	/	/	/
Sum	43 (18)	71 (30)	69 (3)	43 (18)	111 (48)	19 (9)	7 (3)	2 (1)

Appendix G. Regional summary of ecological appraisal techniques (sum, %)

	Habscore	RCS	RHS	RIVPACS	Fisheries survey	PHABSIM	SERCON	Invertebrate/ macroinvertebrate survey	Faunal survey	Botanical survey
Anglian	/	4 (18)	1 (5)	/	5 (23)	/	/	/	1 (5)	2 (9)
Midlands	/	2 (11)	4 (22)	/	3 (17)	/	/	1 (6)	/	1 (6)
North East	2 (20)	1 (10)	/	/	6 (60)	1 (10)	/	/	/	1 (10)
North West	1 (5)	10 (53)	5 (26)	7 (37)	5 (26)	1 (5)	/	/	/	3 (16)
Southern	/	3 (14)	1 (5)	1 (5)	7 (32)	/	/	2 (9)	/	/
South West	1 (4)	4 (16)	4 (16)	4 (16)	16 (64)	2 (8)	/	1 (4)	/	5 (20)
Thames	2 (2)	26 (31)	11 (13)	9 (11)	29 (35)	/	1 (1)	8 (10)	4 (5)	9 (11)
Wales	1 (7)	2 (14)	1 (7)	2 (14)	5 (36)	2 (14)	/	/	/	1 (7)
Scotland	/	2 (17)	4 (33)	/	4 (33)	/	1 (8)	2 (17)	/	2 (17)
Northern Ireland	/	2 (29)	/	1 (14)	2 (29)	1 (14)	/	/	1 (14)	/
Sum	7 (3)	56 (24)	31 (13)	24 (10)	82 (35)	7 (3)	2 (1)	14 (6)	6 (3)	24 (10)

Appendix H. Regional summary of public appraisal techniques (sum, %)

	Discussion groups	Public enquiry	Questionnaire surveys
Anglian	6 (27)	/	3 (14)
Midlands	1 (6)	1 (6)	2 (11)
North East	4 (40)	2 (20)	3 (30)
North West	10 (53)	2 (11)	4 (21)
Southern	2 (9)	1 (5)	/
South West	5 (20)	1 (4)	1 (4)
Thames	14 (17)	3 (4)	5 (6)
Wales	3 (21)	2 (14)	/
Scotland	2 (17)	1 (8)	/
Northern Ireland	1 (14)	/	/
Sum	48 (21)	13 (6)	18 (8)

Appendix I. Regional summary of pollution appraisal techniques (sum, %)

	Monitoring of contaminated land	Water quality monitoring
Anglian	/	/
Midlands	/	2 (11)
North East	2 (20)	2 (20)
North West	2 (11)	10 (53)
Southern	1 (5)	3 (14)
South West	/	4 (16)
Thames	2 (2)	8 (10)
Wales	2 (14)	4 (29)
Scotland	/	2 (17)
Northern Ireland	1 (14)	1 (14)
Region not defined	/	1 (6)
Sum	10 (4)	36 (15)

Appendix J. List of people involved in the Queen's Mead restoration project

	Role during the project	Duration of stay on project
NRA Study Review Team:		
Adrian Meadley	Project Manager, Engineering Services	1994-1998
Andy Pepper	Project Engineering Services (PES)	1994-1995
Richard Copas	Regional Landscape Architect	From 1989+
Trevor Odell	Flood defence officer	1998+
Alastair Driver	Conservation Manager	•
Andrea Szabados	Groundwater Protection Officer	•
Andrew Brookes	Environmental Assessment Officer	At start
Bunny Chea	Flood Hydrologist	•
Dave Elford	Senior Water Resources Officer, South East	•
David de Coster	Senior Pollution Officer	•
David Webb	Conservation officer, South East	•
Graham Hawes	Operation Manager	•
Jim Linwood	Planning Engineer	•
John Gardiner	Technical Planning Manager	At start
Judy England	Biologist	•
Kevin Patrick	Landscape Architect, Project manager	1994-1998
Steve Colclough	Area Fisheries Officer	•
Tim Knight	Catchment Planning Officer, South East	•
London Borough of Bromley:		
Christine Cranfield	Project Officer	1998+
Colin Buttery	Parks and conservation manager	1994-1997
Patricia Goodwin	Senior park strategy officer	1994-1997
Peter Joyce	Chief Landscape Architecture Officer	1991-1998
Susan Sullis	Landscape Development Manager	1991+
Consultants:		
Babtie group	Geomorphologists	2000+
Chris Blanford Associates	Feasibility study	1994
Land use consultants	River landscape assessment	1992
Sub-Consultants:		
Hugh Cushing and Associates	Architectural Illustrations	•
Lewin Fryer Partnership	Consulting Engineers	•
Capital Surveys Ltd	Consulting Land Surveyors	•
Walfords	Quantity Surveyors	•
Flood Hazard Research Centre:		
Maureen Fordham	Manager of research centre	1991-1992
Sue Tapsell	Research fellow	1991-1992
Sylvia Tunstall	Associate research manager	1991-1992
Halcrow:		
John Canton	Engineers, Hydrogeological work	1996-1998
Roland Grzybek	Engineers, Hydrogeological work	•
Statutory undertakers:		
British telecom	Services on Queen's Mead site	•
London electricity board	Services on Queen's Mead site	•
Mercury communications Ltd	Services on Queen's Mead site	•
South East gas	Services on Queen's Mead site	•
Thames Water plc		•
Key	• = Involved for short duration on projects	

Appendix K. List of people included in the RRP management structure

RRP Board:	Roger Bettess	Project Manager - Rivers Group HR Wallingford Ltd, Wallingford
	Lyndis Cole	Principal, Land Use Consultants, London
	Nick Haycock	Principal, Quest Environmental, St Albans
	Nigel Holmes	Chairman RRP, Huntingdon
	Malcolm Newson	University Professor, University of Newcastle, Newcastle Upon Tyne
	Anne Powell	Board Member, Environment Agency, Oxon
	David Sear	Lecturer, Southampton University, Southampton
	Brian Smith	Project Manager, Medway River Project, Kent
	Chris Spray	Recreation & Conservation Manager Northumbrian Water Plc, Darlington
RRP Steering Group:	Phil Boon	Head of Aquatics Environment Branch, Scottish Natural Heritage, Edinburgh
	Richard Britton	Conservator (Greater Yorkshire), The Forestry Authority, York
	Roger Hanbury	Environmental and Scientific Services Manager, British Waterways, Gloucester
	Paul Jose	Wetland Advisor, RSPB, Sandy
	Andy Neale	Senior Countryside Officer, Countryside Commission, Cheltenham
	Mogens Nielsen	Project Leader, LIFE Project (UK&DK), Denmark
	David Noble	Principal, David Noble & Associates, Huntingdon
	Paul Raven	Head of Conservation, EA, Bristol
	Andy Swash	Conservation Policy Advisor, MAFF Flood Defence Division, London
	Roger Thompson	Environmental Manager, Rivers Agency, Belfast
	Chris Tydeman	Head of UK Programmes & European Liaison, World Wide Fund for Nature, Godalming
	David Withrington	Senior Freshwater Officer, English Nature, Peterborough
	Alan Woods	Environment & Water Adviser, Country Landowners Association, London
RRP Officers:	Jeremy Biggs	Environmental Manager RRP, Oxford
	Martin Janes	Project Co-ordinator, RRP, Silsoe, Beds
	Deirdre Murphy	Community Liaison Officer, RRP, Darlington
	Richard Vivash	General Manager, RRP, Huntingdon
RRP Technical Group	Andrew Brookes	Manager for Risk Analysis and Options Appraisal, EA, London
	Olivia Clymer	Project Officer, EA, York
	Alastair Driver	Regional Conservation Manager EA, Reading
	Maureen Fordham	Lecturer, Anglia Polytechnic University, Cambridge
	John Gardiner	Professor, Middlesex University, Enfield
	Valerie Holt	Area Conservation & Recreation Officer, EA, Severn-Trent Region, Nottingham
	Pam Nolan	Senior Ecologist, EA, Sale

Appendix L. List of people involved in the CRRP and their role in this project

Cole Project Board:	Stu Darby	Area Manager West, EA, Wallingford
	David Henshilwood	Team Manager, English Nature,Newbury
	Nigel Holmes (Chair)	Chairman, RRP, Huntingdon
	Richard Morris	Estates Manager, The National Trust, Swindon
	Anne Powell	Board Member, EA, Oxon
	Carolyn Worfolk	Countryside Officer, Countryside Commission, Bristol
Cole Working Group:	Keith Blaxhall	Senior Warden, The National Trust, Swindon
	Andrew Brookes	Manager for Risk Analysis and Options Appraisal, EA, London
	Graham Bryant	Project Officer, Great Western Community Forest Project, Swindon
	Richard Copas	Regional Landscape Architect, EA, Reading
	Roger Davis	Project Manager, EA, Wallingford
	Alastair Driver	Regional Conservation Manager, EA, Reading
	Karen Fisher	Projects Engineer, HR Wallingford Ltd, Wallingford
	Nick Haycock	Principal, Quest Environmental, St Albans
	Andy Killingbeck	Fisheries Officer, EA, Wallingford
	Richard Morris	Estates Manager, The National Trust, Swindon
	Colin Platt (Chair)	Project Manager, EA, Wallingford
	David Sear	Lecturer, Southampton University, Southampton
	Gordon Spoor	Professor in Agricultural Engineering, Silsoe College, Beds
	John Steel	Principal Biologist, EA, Reading
RRC Technical Group:	Alastair Driver	Regional Conservation Manager, EA, Reading
	Jeremy Biggs Environmental Manager	Freshwater Biologist, The Ponds Conservation Trust, Oxford Brookes University, Oxford
		Civil engineer, Riverscape consultancy, Wiltshire Also RRC founder and board member
	Richard Vivash General Manager	Centre manager, River Restoration Centre, Beds
	Martin Janes Project co-ordinator	
RRC board:	Nigel Holmes Chairman	Chairman, RRP, Huntingdon also founder member, Alconbury environmental consultancy
	David Sear	Lecturer in Fluvial geomorphology, Southampton University, Southampton
Consultants:	Sylvia Tunstall	Associate research manager, Flood Hazard Research Centre, Middlesex University, Middlesex
	Sue Tapsell	Research fellow, Flood Hazard Research Centre, Middlesex University, Middlesex

Appendix M. QMRG scheme objectives, opportunities and constraints

Objectives:

a) Provide at least the same level of flood protection as afforded by the existing scheme,
b) Improve the aesthetic, landscape and nature conservation value of the site,
c) 'Re-naturalise' the river channel, within the constraints of the site, and
d) Introduce an element of flood storage within the site as part of the NRA Thames Region Strategy for flood management

Opportunities:

a) Recreating and revitalising the central focus of this public open space so that it is no longer publicly perceived as an eyesore but an asset,
b) Encouraging public access to the channel, at present denied, allowing the public to fully 'experience' the river, and
c) Publicising the work of the NRA and the London Borough of Bromley on river restoration in general, and this scheme in particular

Constraints:

a) Underground services,
b) Ground conditions,
c) Spoil disposal,
d) Nature conservation, and
e) Logistics

Source adapted from NRA, 1994 2

Appendix N. Questionnaire responses to proposed river restoration scheme at QMRG

Questionnaire response 1-3. I don't know if I like this scheme or not because

- I am not convinced that the new proposed scheme will not lead to flooding Also who will be responsible for flood damage done to the property
- It does not convince me of stopping flooding

Questionnaire response 4. I do not like the proposal and I think the scheme should only go ahead if the following changes are made

- Greater study of river behaviour
- People would be able to paddle down the river and get into my garden
- A grid was previously under the bridge and this collected rubbish and could lead to the river bursting its banks
- Playing fields will be too boggy to play on for a while
- River smell and insect implications
- Will the area be maintained?
- If work is not completed by summer 95, will work be halted until following spring?
- How much disruption and noise?
- If there is a flood when work is being carried out what will happen?

Questionnaire response 5-14. I like the proposals and think the scheme should go ahead, but I would like to see the following improvements made

- Bearing in mind the significantly higher proportional of older people in Shortlands, I feel their recreational needs should have a priority e g seating, wheelchair access For elderly residents in special housing locally, this is their nearest park, as it is owner occupied
- Provision of large growing trees to replace 100ft elms lost in 1972
- Flood bund wall disguised a little so looks more natural Same goes for arrangement of stonewalling at village end of river
- Mature waterside trees and reduced vandalism, creation of pools and shallows by natural weirs
- A few carefully placed rocks in the new river (stepping-stones) would add interest to the flow pattern through the water
- As a science/geography resource for the local school this scheme could be superb
- Provision made that LBB will upgrade the maintenance of the area and do all they can to discourage vandalism and maintain damage caused by bored children
- Would make the park more attractive and river accessible to people of all ages
- At the moment the river is a wasted resource

Questionnaire response 15-24. I like the proposals and think the scheme, as currently designed, should go ahead

Source adapted from Ravensbourne project archives, stored at EA Thames region, Reading (Department of fisheries and conservation)

Appendix O. Letter from a local resident (Anon) at QMRG to Adrian Meadley (22/12/1994)

Dear Sir,

Further to our conversation with Mr Pepper at the public meeting last Monday week, we should like to make the following points:

We are greatly concerned that the canalised stream will be demolished and replaced with a 1 and 100 year bund, which will mean that during flooding, water will find its own level and flood the sub-soil.

During the 1968 flood we had water spouting up through our cellar floors to a depth of five feet. We had the fire service pumping out the cellars for nearly a week and then we siphoned, using garden hose, for a further month.

If you wish to make an inspection of the sub-soil we should be pleased to be of assistance as we have the area under out kitchen next to the cellars where the soil remains showing the footings of the house.. Secondly will the contractors have a penalty to fund the much increased upkeep in the coming years.

Anon

Source: adapted from Ravensbourne project archives, stored at EA Thames region, Reading (Department of fisheries and conservation)

Appendix P. Comparison of two projects available for Phase 3 on the UKRP

Criteria	Durnsford Mill	Hoppers Lane
1 Owner support	River tenant is supportive, land tenant requires a lot of detailed and formal agreements	High level of support
2 Degradation or reasonable quality	No significant difference between sites, both severely degraded	
3 Size	350metres	120metres
4 Value for money	Approx cost is £238/metre	Approx cost is £433/metre
5 Practicality	Most difficult technical issues Poor access for construction	Very poor access for construction
6 Consents	Most critical for flood defence	All consents are less contentious
A Land ownership and tenancy	Single owner but with different river and land tenants	Single
B Consultation and agreements	Owner, fishery tenant and adjacent land tenant and his agent	Single owner
C Neighbours	Residential properties overlook site	Possible concern if pond supplies material
D Flood risks	May be sensitive- but o over-spill safety measures included	May be sensitive, but design can be compensatory
E Sluice/ water level management	Single river tenancy operator	None
F Visibility	From road- c60%	From path- total
G. Restoration of characteristic chalk stream habitat	Yes- diverse with alternating deep and shallow areas	Yes- shallowed main channel
H Adjacent habitats	Large pond key component- habitat status quo as existing also of interest	Deep backwater habitat 'enhances' existing river habitat- may be a pond
I Pressures on river	Low- potential syndicate angling No agriculture	Very low- occasional private fishing Low density sheep at present
J Design costs	May need expensive engineered over-flow structure. Flood modelling will be critical	In-house and simple
K Experimental straw bales	Possible	Possible
L Archaeology	Big watching brief	None if no pond
M Materials	Both sites appear to have gravel at 1 2 metres depth	
N Health and safety	Placement of logs will be in water c1m deep	Work on causeway could be in deep water
O Traffic disruption	At mobilisation and delivery of materials	At mobilisation and delivery of materials could be a serious problems at this site
P Public access	No public access to either of the sites	

Source TW, 2001 4

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